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Brick making in Rizal Province.

QUARTERLY BULLETIN

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THE CONSTRUCTING DIVISION, UNDER THE DIRECTION OF
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C. A. TANSILL, COMPILER OF STATISTICS

The objects of the QUARTERLY BULLETIN are:

1. To show each engineer and employee of the Bureau of Public Works the work of the Bureau as a unit.
2. To show him that his work is a unit part of the whole.
3. To make clear to every provincial and municipal official and to the people the work being done by the Bureau.
4. To make the work of the Bureau of personal interest to all.

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When a bit of sunshine hits ye,
After passing of a cloud,
When a fit of laughter gits ye
An' ye'r spine is feelin' proud,
Don't fergit to up and fling it
At a soul that's feeling blue,
For the minit that ye sling it
It's a boomerang to you.

—From the East.

INTERPRETATION OF CONTRACTS FOR PUBLIC WORKS.

By A. K. JONES.

The subject matter here presented is intended briefly to illustrate the scope and consideration necessary to a proper interpretation of Insular, provincial, and municipal contracts for public works, when and where interpretation may be found to be necessary. It pretends in no sense to be an exhaustive discussion of the subject, but merely to show, in a general way, how in such cases the instrument should be treated.

If the purpose which a contract represents be badly expressed, it is the office of interpretation to discover it and by process of unraveling to produce from the language used the true intent and meaning of the contracting parties, the universal rule being that the contract shall be so construed, or interpreted, if possible, as to carry out that intent.

If there be conflict between the printed, if such be used, and the written portions of the same instrument, the rule is, that which is written shall control. All the circumstances, however, should be taken into consideration and the conflicting portions made to harmonize if possible.

Clauses in a contract are construed according to the evident intention of the parties, and this intention should not be determined from what a clause alone may contain, but reference should be had to other clauses, and the intention of the parties ascertained from their situation and the whole scope of the contract.

Therefore, when it is stipulated in one part of the contract that a certificate by the engineer in charge shall be given monthly of estimates of the work done, upon the presentation of which monthly payments of 90 per cent of the sum named therein shall be made, and in another part of the contract it is provided that if the contractor shall not well and truly perform all the covenants therein contained the Government shall have power to annul the contract, and any balance for work done shall be forfeited and become the right and property of the Government, it is well settled that the termination of the contract does not relieve the Government from the payment of the 90 per cent found due from it prior to such termination.

Under similar circumstances under a contract stipulation that "the unpaid part of the value of the work done shall be forfeited by the contractor to the use of the company in the nature of liquidated damages," it was held that the company could hold only the percentage reserved from the monthly estimates, and it did not authorize it to retain the entire value of the work done since the last estimate. The company was required to account for the actual value of the work done, less the percentage reserved, not alone upon the phraseology of the stipulation, but because it would permit the company under the guise of withholding liquidated damages to inflict a penalty.

The court said:

"It is obvious from the situation of the parties, as well as from the whole scope of the contract itself, that it was intended that 90 per cent stipulated to be paid monthly should be so applied as to enable the contractor to prosecute and complete the work for which he contracted. The construction contended for would put it in the power of the company to embarrass the contractor by withholding his monthly payments, and these, in case he, by reason of such embarrassment, should fail to progress with the work with sufficient rapidity, by their engineer to determine that the work had been abandoned, and any balance due the contractor, however large, forfeited. A construction which should offer so large a premium for wrongdoing should not be adopted unless the language used will admit of no other reasonable explanation. Such explanation may be had by excluding the monthly estimates after they become due from the operation of that provision."

As the necessity of interpretation arises only where there is want of completion, certainty, and clearness in the terms of a contract, therefore, and as heavy losses sometimes result from such want, engineers and officers should exercise the greatest care in the preparation of specifications, terms, and conditions. They should not only provide for present and existing conditions, but should anticipate every difficulty and controversy that may arise in the execution of the contract or the prosecution of the work.

Where the language used in a contract is indefinite or ambiguous, and hence of a doubtful meaning, the practical construction placed upon it by the parties immediately concerned with the preparation and carrying out of its provisions, as shown by their acts or conduct, is entitled to great, if not controlling weight. This, however, does not mean that an erroneous interpretation by these parties will control where the meaning and intent, on the other hand, is clear and contrary to such practical construction.

It has been held, subject to these rules, that the parties are bound by the terms which they have employed. Cases not infrequently arise wherein the language and intent of the parties is clear and free from ambiguity, but wherein the contractor has sought to alter the effect of the language used.

For instance: A contract provides for liquidated damages in case of breach, one or both of the parties may insist in perfect good faith that it was not their intention to so provide, but it was, on the contrary, their intention that actual damages should apply.

Such a contention cannot be sustained; nor is proof admissible in

support thereof. In *Brawley vs. United States* (96 U. S., 173-174), the following language is used:

"The written contract merged all previous negotiations, and is presumed, in law, to express the final understanding of the parties. If the contract did not express the true agreement, it was claimant's folly to have signed it. The court cannot be governed by any such outside considerations. Previous and contemporary transactions and facts may be very properly taken into consideration to ascertain the subject matter of a contract, and the sense in which the parties may have used particular terms, but not to alter or modify the plain language which they have used."

As a man cannot plead ignorance of the law, so he cannot plead ignorance of the effect of the language he has employed. Too much care, it is urged, cannot be exercised in the preparation of contracts.

BRICK.

By H. F. CAMERON,

Member American Society of Civil Engineers,
Member Philippine Society of Engineers.

[See title-page: Brickmaking in Rizal Province.]

During the summer of 1913, while on vacation in the United States, the writer made it a special point to investigate brick, asphalt, and concrete roads as constructed in three distinct localities—California and Washington for the western section; Ohio and Michigan, for the middle section; the city of Washington and Massachusetts, for the eastern section—each differing in local conditions as to moisture, temperature, and prevailing winds, which combine to make one of the most destructive road agents to be considered in the modern road.

This article will treat especially with the brick road as investigated, and its relation to the future needs of the Philippine Islands.

HISTORICAL.

The derivation of the word "brick" as applied to the pavers of burnt clay or shale used for road construction of to-day, as some etymologists assert, came from the Teutonic *bricke*, a disk or plate, but more authoritatively through the French *brique*, originally a "broken piece" applied to bread.

The manufacture of brick dates more than 6,000 years to the civilized nations of antiquity. The earliest burnt bricks known were found in the sites of the ancient cities of Babylonia, and the modern towns in the surrounding country are made from brick taken from the ruins of these ancient cities.

The Chinese claim great antiquity in the art of brickmaking, but there is nothing to show that the Chinese knew anything of bricks when the art flourished in Babylonia. Part of the great wall in China is constructed of brick, but this wall dates back to 210 B. C. only.

The Israelites, during their bondage in Egypt, made bricks of clay mixed with chopped straw or reeds worked into a stiff paste of water and River Nile mud, then dried in the sun.

To the Romans, however, must be attributed the greatest advance in brick manufacture by burning bricks in kilns. They introduced the art into Britain and Germany nearly 2,000 years ago, but it disappeared when they left. It was reintroduced into England in 1210 and has increased in importance ever since. In 1625 a standard-size paver of 9 by 4½ by 3 inches was adopted in England as best adapted to the needs of the time.

In the United States the first brick known were imported from Holland and used for building purposes on Manhattan Island, New York. The first known brick factory in the United States was erected at New Haven, Connecticut, in 1650, but the brick was all used on other construction than road. It was at Charlestown, West Virginia, in 1872 that the first brick was used for roads and found to be of practicable application for heavy traffic. Its superiority, in so many features over other materials for traffic conditions, has become such a recognized factor for road construction that its use is becoming more and more the material for modern road requirements.

In certain sections of Europe brick roads are the only ones that satisfy traffic and local conditions.

In Holland two-thirds of the State roads are of brick. The prin-

cipal road material in Holland is a poor class of gravel that ruts quickly, besides being either very dirty or muddy. To offset these conditions, a standard road section is used that has a central section of brick upon a compressed sand base for the horses to travel on, with



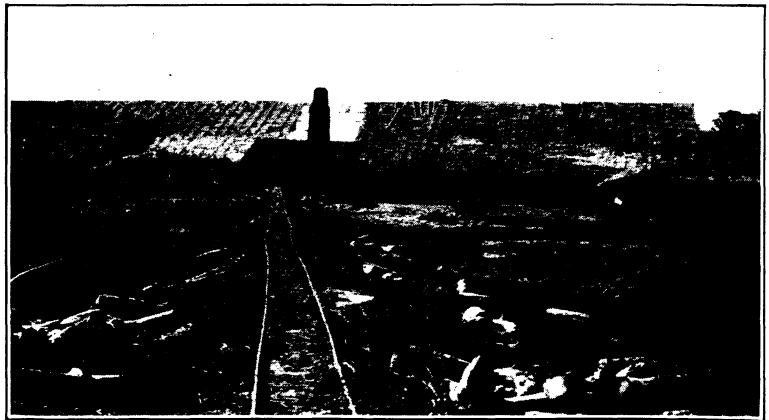
Pugmill at the Javellana brick plant, Iloilo.

gravel for the wheel base. The brick size in use is approximately 2 by 4 by 8 inches, but in south Holland this size is reduced to 1½ by 3½ by 7 inches and form excellent roads.

In Russia the vitrified-brick plants are owned by the Government and the total output is used on State roads. The chemical analysis of one of the Russian clays used for brick manufacture is:

Silica:	Per cent.
Free	69.60
Combined	10.51
Alumina	8.70
Ferric oxide	3.04
Lime85
Carbonic acid71
Magnesia oxide77
Water	5.70
Total	99.88

The manufacture of brick in the Philippines dates back to 1587, and was started by Governor and Captain General Santiago de Vera, according to a letter to the Sacred Royal Catholic Majesty, Felipe II. It seems that early Manila was constructed of bamboo and other light material and had been gutted by fire on various occasions, so this governor debarred further light-material construction and ordered all buildings constructed of either stone or brick. This caused brick to be shipped from Mexico for a short period until the governor of Mexico, Marques de Villa-Manrique, stopped the exportation. This forced the people to make their own brick, and many Chinese entered the industry near Manila.



Molding and drying shed with one kiln at Javellana brick plant, Iloilo.

These bricks in 1588 sold at a price of 8 reals (#1) a 1,000 bricks, and the new Manila was constructed of brick and stone. In 1629 the best church in the Philippines was constructed at Lubao, Pampanga Province, of brick made in that province.

The Philippine census of 1903 states that there were 27 brick and tile plants in active operation in the Provinces of Bulacan, Capiz, Rizal, Iloilo, Ilocos Norte, Isabela, Marinduque, Masbate, and Pangasinana.

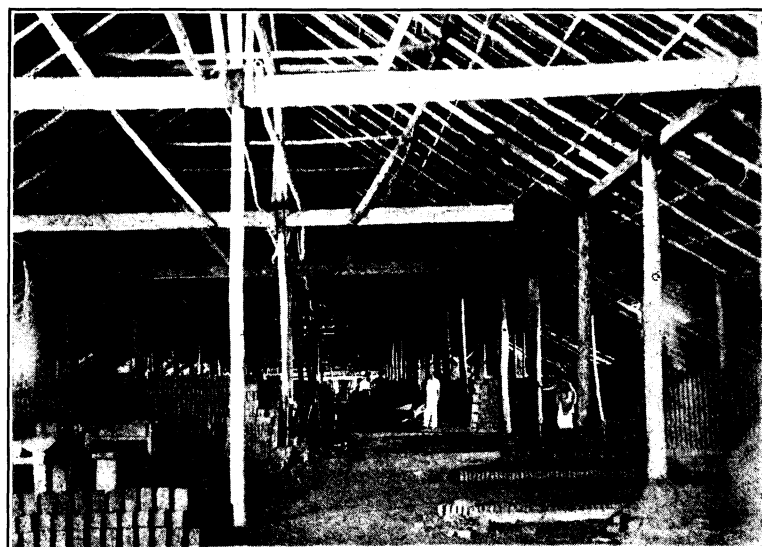
In the industries of the Islands these plants ranked 16 in amount of capital invested, 8 in number of people employed, 17 in average monthly wage paid, and 15 in value of products. The yearly value of these products amounted to ₱457,790, the capital invested amounted to ₱237,543, and the cost of raw materials used was ₱72,840. These establishments had a daily labor roll of 954 employees.

The sizes and values of the articles manufactured are as follows:

Article.	Size in inches.	Price per 1,000.
Tile	10½ by 10½ by 1	₱80-₱100
Brick No. 3	4½ by 8½ by 2	22- 25
Cornice	3½ by 10½ by 2	22- 25
Half brick	4½ by 9½ by 1	16

MATERIALS FOR CONSTRUCTION.

The general material for brick construction is clay. All clays are the result of the denudation and decomposition of felspathic and silicious rocks, and consist of the fine insoluble particles which have



A view of the interior of the molding and drying shed at the Jalandoni brick plant, Iloilo.

been carried in suspension in water and deposited in geologic basins according to their specific gravity and degree of fineness. These deposits have been formed in all geologic epochs from the "Recent" to the "Cambrian," and they vary in hardness from the soft and plastic "alluvial" clays to the hard and rocklike shales and slates of the older formations. The alluvial and drift clays (which were alone used for brickmaking until modern times) are found near the surface, are readily worked, and require little preparation; whereas the older sedimentary deposits are often difficult to work and necessitate the use of heavy machinery. These older shales, or rocky clays, may be brought into plastic condition by long weathering (i. e., by exposure to rain, frost, and sun) or by crushing and grinding in water, and they then resemble ordinary alluvial clays in every respect.

The clays or earths from which burnt bricks are made may be divided into two principal types, according to chemical composition: (1) Clays or shales containing only a small percentage of carbonate of lime and consisting chiefly of hydrated aluminium silicates (the "true clay substance") with more or less sand, undecomposed grains of feldspar, and oxide or carbonate of iron; these clays usually burn to a buff, salmon, or red color. (2) Clays containing a considerable percentage of carbonate of lime in addition to the substances above mentioned. These latter clay deposits are known as "marls" and may contain as much as 40 per cent of chalk. They burn to a sulphur-yellow color, which is quite distinctive.

Brick clays of class (1) are very widely distributed and have a more extensive geological range than the marls, which are found in connection with chalk or limestone formations only. These ordinary brick clays vary considerably in composition, and many clays as they are found in nature are unsuitable for brickmaking without the addition of some other kind of clay or sand. The strongest brick clays, i. e., those possessing the greatest plasticity and tensile strength, are usually those which contain the highest percentage of the hydrated aluminium silicates, although the exact relation of plasticity to chemical composition has not yet been determined. This statement cannot be applied indiscriminately to all clays, but may be taken as fairly applicable to clays of one general type. All clays contain more or less silica in the form of sand, and usually a small percentage of undecomposed feldspar. The most important ingredient, after the clay substance and the sand, is oxide of iron; for the color, and, to a less extent, the hardness and durability of the burnt bricks depend on its presence. The amount of oxide of iron in these clays varies from about 2 to 10 per cent, and the color of the bricks varies accordingly from light buff to chocolate, although the color developed by a given percentage of oxide of iron is influenced by the other substances present and also by the method of firing. A clay containing from 5 to 8 per cent of oxide of iron will, under ordinary conditions of firing, produce a red brick; but if the clay contains 3 to 4 per cent of alkalis, or the brick is fired too hard, the color will be darker and purple. The actions of the alkalis and of increased temperature are probably closely related, for in either case the clay is brought nearer to its fusion point, and ferruginous clays generally become darker in color as they approach to fusion. Alumina acts in the opposite direction, an excess of this compound tending to make the color lighter and brighter. It is impossible to give a typical composition for such clays, as the percentages of the different constituents vary through such wide ranges. The clay substance may vary from 5 to 80 per cent, the oxide of iron from 1 to 10 per cent, the carbonates of lime and magnesia together from 1 to 5 per cent, and the alkalis from 1 to 4 per cent. Organic matter is always present, and other impurities which frequently occur are the sulphates of lime and magnesia, the chlorides and nitrates of soda and potash, and iron pyrites. The presence of organic matter gives the wet clay a greater plasticity, probably because it forms a kind of mucilage which adds a certain viscosity and adhesiveness to the natural plasticity of the clay. In some of the coal-measure shales the amount of organic matter is very considerable, and may render the clay useless for brickmaking. The other impurities, all of which, except the pyrites, are soluble in water, are undesirable, as they give rise to "scum," which produces patchy color and pitted faces on the bricks. The commonest soluble impurity is calcium sulphate, which produces a whitish scum on the face of the brick in drying and as the scum becomes permanently fixed in burning, such bricks are of little use except for common work. This question of "scumming" is very important to the maker of high-class facing and molded bricks, and where a clay containing calcium sulphate must be used, a certain percentage of barium carbonate is nowadays added to the wet clay. By this means the calcium sulphate is converted into calcium carbonate which is insoluble in water, so that it remains distributed throughout the mass of the brick instead of being deposited on the surface. The presence of magnesium salts is also very objectionable, as those generally remain in the burnt brick as magnesium sulphate, which gives rise to an efflorescence of fine white crystals after the bricks are built into position. Clays which are strong or plastic are known as "fat" clays, and they always contain a high percentage of true "clay substance," and, consequently, a low percentage of sand. Such clays take up a considerable amount of water in "tempering;" they dry slowly, and shrink greatly, and so become liable to lose their shape and develop cracks in drying and firing. "Fat" clays are greatly improved by the addition of coarse, sharp sand, which reduces the time of drying and the shrinkage, and makes the brick more rigid during the firing. Coarse sand, unlike clay substance, is practically unaffected during the drying and firing, and is a desirable if not a necessary ingredient of all brick clays. The best brick clays feel gritty between the

fingers; they should, of course, be free from pebbles, sufficiently plastic to be molded into shape, and strong enough when dry to be safely handled. All clays are greatly improved by being turned over and exposed to the weather, or by standing for some months in a wet condition. This "weathering" and "aging" of clay is particularly important where bricks are made from tempered clay, i. e., clay in the wet or plastic state; where bricks are made from shales, in the semiplastic condition, weathering is still of importance.

The lime clays, or "marls" of class (2), which contain essentially a high percentage of chalk or limestone, are not so widely distributed as the ordinary brick clays, and in England the natural deposits of these clays have been largely exhausted. A very fine chalk clay, or "malm" as it was locally called, was formerly obtained from the

in grain. Another method of treating these marls, when they are in the plastic condition, is to squeeze them by machinery through iron gratings, which arrest and remove the pebbles. In other cases the marl is passed through a grinding mill having a solid bottom and heavy iron rollers, by which means the limestone pebbles are crushed sufficiently and mixed through the whole mass. The removal of limestone pebbles from the clay is of great importance, as during the firing they would be converted into quicklime, which has a tendency to shatter the brick on exposure to the weather. As before stated, these marls (which usually contain from 15 to 30 per cent of calcium carbonate) burn to a yellow color which is quite distinctive, although in some cases, where the percentage of limestone is very high, over 40 per cent, the color is gray or a very pale buff. The



Crude pugmill of Visara brick plant at San Pedro Macati, Rizal Province.

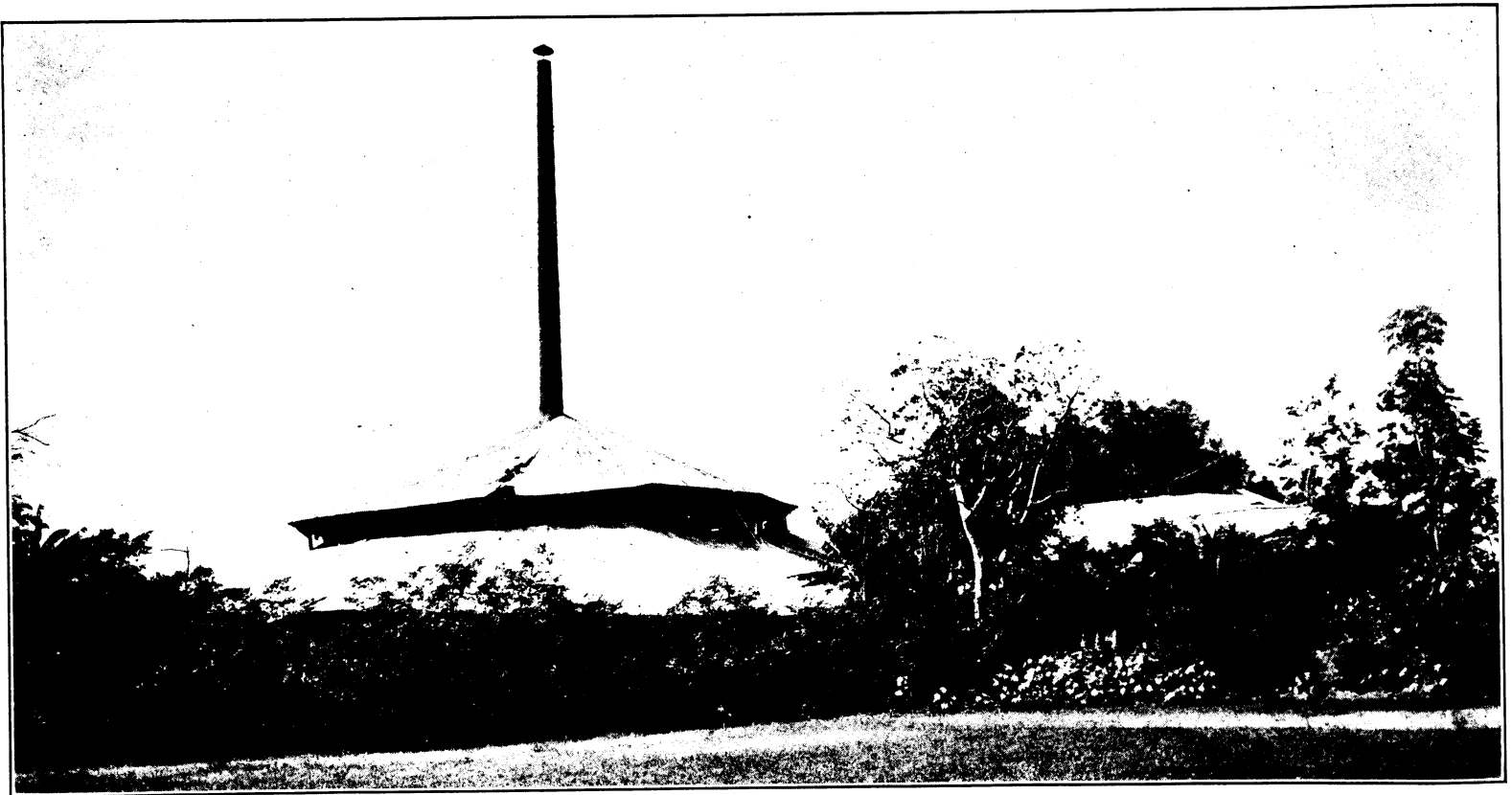
alluvium in the vicinity of London; but the available supply of this has been used up, and at the present time an artificial "malm" is prepared by mixing in water. The chalk is ground on grinding pans, and the clay is mixed with water and worked about until the mixture has the consistency of cream. The mixture of these "pulp" is run through a grating or coarse sieve onto a drying kiln or "bed," where it is allowed to stand until stiff enough to walk on. A layer of fine ashes is then spread over the clay, and the mass is turned over and mixed by spade and tempered by the addition of water. In other districts, where clays containing limestone are used, the marl is mixed with water on a wash pan and the resulting creamy fluid passed through coarse sieves onto a drying bed. If necessary, coarse sand is added to the clay in the wash pan, and such addition is often available because the washed clays are generally very fine

action of lime in bleaching the ferric oxide and producing a yellow instead of a red brick has not been thoroughly investigated, but it seems probable that some compound is produced, between the lime and the oxide of iron, or between these two oxides and the free silica, entirely different from that produced by oxide of iron in the absence of lime. Such marls require a harder fire than the ordinary brick clays in order to bring about the reaction between the lime and the other ingredients. Magnesia may replace lime to some extent in such marls, but the firing temperature must be higher when magnesia is present. Marls usually contract very little, if at all, in the burning, and generally produce a strong, square brick of fine texture and good color. When underfired, marl bricks are very liable to disintegrate under the action of the weather, and great care must be exercised in burning them at a sufficiently high temperature.

METHOD OF MANUFACTURE.

Bricks made of tempered clay may be made by hand or by machine, and the machines may be worked by hand or by mechanical power. Bricks made of semiplastic clay (i. e., ground clay or shale sufficiently damp to adhere under pressure) are generally machine-made throughout. The method of making bricks by hand is the same, with slight variation, the world over. The tempered clay is pressed by hand into a wooden or metal mold or four-sided case (without top or bottom) which is of the desired shape and size, allowance being made for the shrinkage of the brick in drying and firing. The molder stands at the bench or table, dips the mold in water, or water and then sand, to prevent the clay from sticking, takes a rudely shaped piece of clay from an assistant, and dashes this into the mold which rests on the molding bench. He then presses the clay into the corners of the mold with fingers, scrapes off any surplus clay and levels the top by means of a strip of wood called a "strike," and then turns the brick out of the mold onto a board, to be carried away by another assistant to the drying ground. The mold may be placed on a special piece of

condition, grinding mills are only used when pebbles more than a quarter of an inch in diameter are present, as otherwise the clay may be passed directly through the pug mill, a process which may be repeated if necessary. The pug mill consists of a box or trough having a feed hole at one end and a delivery hole or nose at the other end, and provided with a central shaft which carries knives and cutters, so arranged that when the shaft revolves they cut and knead the clay, and at the same time force it toward and through the delivery nose. The cross section of this nose of the pug mill is approximately the same as that of the required brick (9 by 4½ inches plus contraction, for ordinary bricks), so that the pug delivers a solid and continuous mass of clay from which bricks may be made by merely making a series of square cuts at the proper distances apart. In practice, the clay is pushed from the pug along a smooth iron plate, which is provided with a wire cutting frame having a number of tightly stretched wires placed at certain distances apart, arranged so that they can be brought down upon, and through, the clay, and so many bricks cut off at intervals. The frame is sometimes in the



Brick kiln built by Colonel Cordova (Spanish Army) in 1871. Has twelve radial compartments of 12,000 brick capacity each. San Pedro Macati, Rizal Province. (Old plant.)

wood, called the stock board, provided with an elevated tongue of wood in the center, which produces the hollow or "frog" in the bottom of the brick.

Machine-made bricks may be divided into two kinds, plastic and semiplastic, although the same type of machine is often used for both kinds.

The machine-made plastic bricks are made of tempered clay, but generally the tempering and working of the clay are effected by the use of machinery, especially when the harder clays and shales are used. The machines used in the preparation of such clays are grinding mills and pug mills. The grinding mills are either a series of rollers with graduated spaces between, through which the clay or shale is passed, or are of the ordinary "mortar pan" type, having a solid or perforated iron bottom on which the clay or shale is crushed by heavy rollers. Shales are sometimes passed through a grinding mill before they are exposed to the action of the weather, as the disintegration of the hard lumps of shale greatly accelerates the "weathering." In the case of ordinary brick clay, in the plastic

form of a skeleton cylinder, the wires being arranged radially (or the wire may be replaced by metal disks); but in all cases bricks thus made are known as "wire cuts." In order to obtain a better-shaped and more compact brick, these wire cuts may be placed under a brick press and there squeezed into iron molds under great pressure. These two processes are now generally performed by one machine, consisting of pug mill and brick press combined. The pug delivers the clay downwards into the mold; the proper amount of clay is cut off; and the mold is made to travel into the position under the ram of the press, which squeezes the clay into a solid mass.

There are many forms of the brick press, a few for hand power, but the most adapted for belt driving, although in recent years hydraulic presses have come more and more into use, especially in Germany and America. The essential parts of a brick press are: (1) A box or frame in which the clay is molded; (2) a plunger or die carried on the end of ram, which gives the necessary pressure; (3) an arrangement for pushing the pressed brick out of the molding box. Such presses are generally made of iron throughout, although

other metals are used occasionally for the molds and dies. The greatest variations found in brick presses are in the means adopted for actuating the ram; and many ingenious mechanical devices have been applied to this end, each claiming some particular advantage over its predecessors. In many recent presses, especially where semiplastic clay is used, the brick is pressed simultaneously from top and bottom, a second ram, working upwards from beneath, giving the additional pressure.

Although the best bricks are still pressed from tempered or plastic clay, there has recently been a great development in the manufacture of semiplastic or dust-made bricks, especially in those districts where

producing a so-called "semiplastic" brick. The presses used are similar to those employed for plastic clay, but they are generally more strongly and heavily built, and are capable of applying a greater pressure.

The semiplastic method has many advantages where shales are used, although the bricks are not as strong nor as perfect as the best "plastic" bricks. The method, however, enables the brickmaker to make use of certain kinds of clay rock, or shale, that would be impracticable for plastic bricks; and the weathering, tempering, and "aging" may be largely or entirely dispensed with. The plant required is heavier and more costly, but the brickyard becomes more



Top of brick kiln built by Colonel Cordova in 1871, showing vents and the fuel receivers (covered holes) of the twelve radial compartments, San Pedro Macati, Rizal Province. (Old plant.)

shales are used for brickmaking. These semiplastic bricks are stamped out of ground shale that has been sufficiently moistened with water to enable it to bind together. The hard clay, or shale, is crushed under heavy rollers in an iron grinding pan having a perforated bottom through which the crushed clay passes, when sufficiently fine, into a small compartment underneath. This clay powder is then delivered by an elevator into a sieve or screen, which retains the coarser particles for grinding. Sets of rollers may also be used for crushing shales that are only moderately hard, the ground material being shifted as before. The material as fed into the mold of the press is a coarse, damp powder which becomes adhesive under pressure,

compact and the processes are simpler than with the "plastic" method.

The drying of bricks, which was formerly done in the open, is now in most cases conducted in a special shed heated by flues along which the heated gases from the kilns pass on their way to the chimney. It is important that the atmosphere of the drying shed should be fairly dry, to which end suitable means of ventilation must be arranged (by fans or otherwise). If the atmosphere is too moist the surface of the brick remains damp for a considerable time, and the moisture from the interior passes to the surface as water, carrying with it the soluble salts, which are deposited on the surface as the water slowly evaporates. The deposit produces the "scum" already

referred to. When the drying is done in a dry atmosphere the surface quickly dries and hardens, and the moisture from the interior passes to the surface as vapor, the soluble salts being left distributed through the whole mass, and consequently no "scum" is produced. Plastic bricks take much longer to dry than semiplastic; they shrink more and have a greater tendency to warp or twist.

The burning or firing of bricks is the most important factor in their production; for their strength and durability depend very largely on the character and degree of the firing to which they have been subjected. The action of the heat brings about certain chemical decompositions and recombinations which entirely alter the physical character of the dry clay. It is important, therefore, that the firing should be carefully conducted and that it should be under proper

bricks in a series of rows or walls, placed fairly closely together, so as to form a rectangular stack. A certain number of channels, or fire mouths, are formed in the bottom of the clamp; and fine coal is spread in horizontal layers between the bricks during the building up of the stack. Fires are kindled in the fire mouths, and the clamp is allowed to go on burning until the fuel is consumed throughout. The clamp is then allowed to cool, after which it is taken down and the bricks sorted; those that are underfired being built up again in the next clamp for firing. Sometimes the clamp takes the form of a temporary kiln, the outside being built of burnt bricks which are plastered over with clay, and the fire mouths being larger and more carefully formed. There are many other local modifications in the manner of building up the clamps, all with the object of producing a large percentage of



Brick drying room at Visara plant, San Pedro Macati, Rizal Province.

control. For ordinary bricks the firing atmosphere should be oxidizing, and the finishing temperature should be adjusted to the nature of the clay, the object being to produce a hard, strong brick, of good shape, that will not be too porous and will withstand the action of frost. The finishing temperature ranges from 900° to $1,250^{\circ}$ C., the usual temperature being about $1,050^{\circ}$ C., for ordinary bricks. As before mentioned, lime clays require a higher firing temperature (usually about $1,150^{\circ}$ to $1,200^{\circ}$ C.), in order to bring the lime into chemical combination with the other substances present.

It is evident that the best method of firing bricks is to place them in permanent kilns; but although such kilns were used by the Romans some two thousand years ago, the older method of firing in "clamps" is still employed in the smaller brickfields in every country where bricks are made. These clamps are formed by arranging the unfired

well-fired bricks. Clamp firing is slow and also uneconomical, because irregular and not sufficiently under control, and it is now only employed where bricks are made on a small scale.

Brickkilns are of many forms, but they can all be grouped under two main types—intermittent kilns and continuous kilns. The intermittent kiln is usually circular in plan, being in the form of a vertical cylinder with a domed top. It consists of a single firing chamber in which the unfired bricks are placed, and in the wall of which are contrived a number of fire mouths where wood or coal is burned. In the older forms known as *updraft* kilns, the products of combustion pass from the fire mouth through flues into the bottom of the firing chamber, and thence directly upwards and out of the top. The modern plan is to introduce the products of combustion near the top, or crown, of the kiln and to draw them downwards through holes

in the bottom which lead to flues connected with an independent chimney. These *down-draft* kilns have short chimneys or "bags" built around the inside wall in connection with the fire mouths, which conduct the flames to the upper part of the firing chamber, where they are reverberated and passed down through the bricks in obedience to the pull of the chimney. The "bags" may be joined together, forming an inner circular wall entirely round the firing chamber, except at the doorway; and a number of kilns may be built in a row or group having their bottom flues connected with the same tall chimney. Down-draft kilns usually give a more regular fire and a higher percentage of well-fired bricks; and they are more economical in fuel consumption than updraft kilns, while the hot gases, as they pass from the kiln, may be utilized for drying purposes, being conducted through flues under the floor of the drying shed on their way to the chimney. The method of using one tall chimney to work a group of down-draft kilns naturally led to the invention of the "continuous" kiln, which is really made up of a number of separate kilns or firing chambers, built in series and connected up to the main flue of the chimney in such a manner that the products of combustion from the kiln may be made to pass through a number of other kilns before entering the flue.

The earliest form of continuous kiln was invented by Friedrich Hoffman, and all kilns of this type are built on the Hoffman principle, although there are a great number of modifications of the original Hoffman construction. The great principle of "continuous" firing is the utilization of the waste heat from one kiln or section of a kiln in heating up another kiln or section, direct firing being applied only to finish the burning. In practice, a number of kilns or firing chambers, usually rectangular in plan, are built side by side in two parallel lines, which are connected at the ends by other kilns so as to make a complete circuit. The original form of the complete series was elliptical in plan, but the tendency in recent years has been to flatten the sides of the ellipse and bring them together, thus giving two parallel rows joined at the ends by a chamber or passage at right angles. Coal or gas is burnt in the chamber or section that is being fired up, the air necessary for the combustion being heated on its passage through the kilns that are cooling down, and the products of combustion, before entering the chimney flue, are drawn through a number of other kilns or chambers containing unfired bricks, which are thus gradually heated up by the otherwise waste heat from the sections being fired. Continuous kilns produce a more evenly fired product than the intermittent kilns usually do, and, of course, at much less cost for fuel. Gas firing is now being extensively applied to continuous kilns, natural gas in some instances being used in the United States of America; and the method of construction and of firing are carried out with greater care and intelligence, the prime objects being economy of fuel and perfect control of firing. Pyrometers are coming into use for the control of firing temperature, with the result that a constant and trustworthy product is turned out. The introduction of machinery greatly helped the brickmaking industry in opening up new sources for supply of raw material in the shales and hardened clays of the sedimentary deposits of the older geologic formations, and, with the extended use of continuous firing plants, it has led to the establishment of large concerns where everything is coördinated for the production of enormous quantities of bricks at a minimum cost. In the United Kingdom, and still more in Germany and the United States of America, great improvements have been made in machinery, firing plant, and organization, so that the whole manufacture is now being conducted on more scientific lines, to the great advantage of the industry.

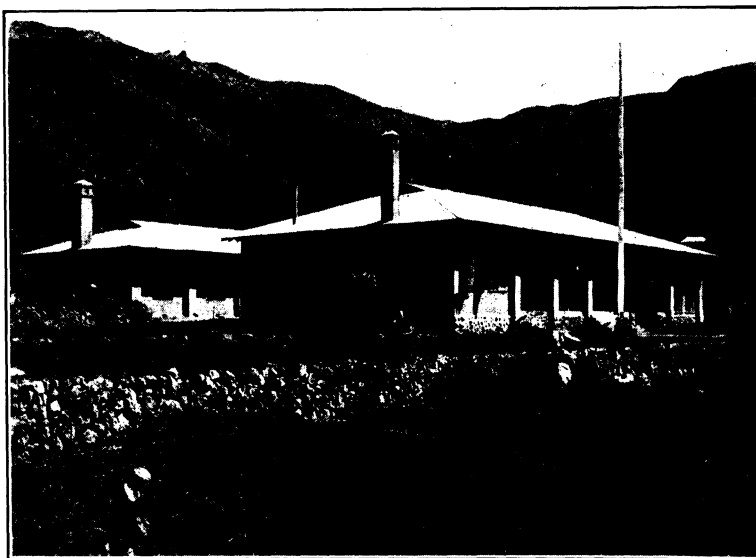
MATERIALS AND MANUFACTURE IN PHILIPPINES.

Dr. Alvin J. Cox, Director of the Bureau of Science, in an article entitled "The occurrence, composition, and radioactivity of the clays from Luzon, Philippine Islands," in the Philippine Journal of Science states that red bricks are made in large quantities in Bulacan, Capiz, Rizal, Ilocos Norte, Isabela, Marinduque, Masbate, and Pampanga; that "the common clays of Luzon are already used in the manufacture of brick and crude pottery."

The analysis of various clays used in the Philippines for brick and pottery is as follows:

TABLE 1.—Analysis of Philippine clays.

Region, province, locality, sample number.	Silica (SiO ₂).	Alumina (Al ₂ O ₃).	Iron (Fe ₂ O ₃), (FeO).	Lime (CaO).	Magnesia (MgO).	Alkalies (Na ₂ O), (K ₂ O).	Total fluxes.	Titanium (TiO ₂).	Loss on ignition.	Water (H ₂ O) below 110° C.
Maquiling, Mount, Laguna Province:										
No. 2, Los Baños	44.15	36.54	1.04	0.15	0.00	0.98	2.17	1.14	13.50	2.64
No. 3, Vicente Jesus mine	43.42	41.48	.32	.04	.59	.38	1.69	—	14.12	—
No. 5, Laguna Province	42.06	32.04	.33	.48	.32	1.17	2.90	1.10	20.42	2.08
No. 6, Los Baños	45.24	37.31	1.00	.66	—	1.69	3.35	.98	12.67	1.24
No. 7, Pajo Arroyo	44.30	37.28	1.47	.39	.42	1.00	3.28	1.36	12.56	1.60
No. 12, Calamba	61.98	26.22	.12	.60	.72	.34	1.78	—	10.55	—
No. 19, Wolfson mine	49.95	31.84	3.96	.36	.70	.64	5.66	—	11.90	—
Bagong Bola Creek	49.42	30.45	1.61	—	.21	.16	1.98	1.11	11.72	5.86
Do	43.83	31.86	5.86	.14	.11	(a)	6.11	.80	15.04	2.71
Pajo Cañon	55.99	28.77	.89	.18	.03	.17	1.27	.91	11.59	2.42
Do	42.23	37.32	1.41	.23	.07	.46	2.17	1.00	15.84	1.92
Do	43.28	37.85	3.39	.08	.04	(a)	3.51	1.25	14.20	.89
Point Alipio	43.16	38.64	1.19	.09	.14	.10	1.52	1.54	14.55	1.42
Nasugbu, Batangas Province:										
No. 13, Nasugbu	62.78	23.85	1.60	.15	—	2.61	4.36	.78	8.84	—
No. 20, east of Nasugbu	65.18	19.07	3.93	—	.28	1.16	5.27	.70	9.04	—
No. 35, near Nasugbu	57.45	18.08	8.40	1.41	—	1.42	11.26	.58	8.56	6.08
Albay Province: Locality not known	71.16	16.94	.48	.57	.23	6.10	7.38	.58	3.22	1.56
Matiquio, Jala Jala Peninsula, Laguna Province	61.00	19.71	3.49	.34	.07	.84	4.73	.95	8.18	5.97
Malinta, Bulacan Province: No. 30, Tinajeros River, alluvial clay	60.24	18.73	7.19	1.78	2.06	1.86	13.04	—	13.84	—
San Pedro Macati, Rizal Province: No. 33, Pasig River	52.53	21.01	8.40	4.04	2.58	2.68	17.70	—	9.08	—
Mandalayon, alluvial clay	—	—	—	—	—	—	—	—	—	—
Laoag, Ilocos Norte Province: Granulite dike, source of "silica"	72.56	15.13	2.54	2.01	.95	5.62	—	(b)	—	.03

^a Small.^b TiO, trace; MnO, 0.46.

Provincial hospital built of brick made by Bontoc Igorots, Bontoc, Bontoc.

In Bulacan Province the manufacture of bricks was very extensively carried on at one period in Baliuag, Calumpit, Obando, and various points adjacent to Angat. These bricks were used principally for building purposes, and as concrete has gradually superseded brick for this purpose the industry has gradually become less until to-day kilns are found only in the barrio of Sabang, Baliuag; Bonga Mayor, Bustos; and in Calumpit, but the brick manufacture has been replaced by the manufacture of sugar pots, cooking pots, native stoves, and water jars. When at rare intervals bricks are made, the clay is molded into a fairly tough and compact mass of a plastic nature, then beaten into wooden forms by means of blocks, and finally fired. Three men mold about 1,000 bricks a day and the brick sells for approximately ₱20 per 1,000.

Clay is found quite generally throughout the province, but the best-known and larger deposits are found near Angat.

The brick industry in Capiz Province has entirely disappeared, though there were two well-known kilns in this province years ago—one in Calivo forty years ago which furnished the bricks for the Calivo Church and another in Capiz twenty years ago, known as La Manchega, which burnt the bricks for the Loctugan and Panay Churches.

There are quite extensive beds of clay in this province awaiting development along industrial lines.

Ilocos Sur Province has four brickkilns in operation varying in capacity from 4,000 to 10,000 bricks, each operated by three men.



Public school built of bricks made by Bontoc Igorots, Bontoc, Bontoc.

The clay used for the manufacture is of a dark yellow in color and very sticky and is extracted from 1 to 2 meters below the ground surface.

It is necessary to add sufficient water to make the mass plastic, when it is kneaded thoroughly before being placed in the molds. Once molded, the bricks are allowed to stand in the air until quite dry, care being taken not to allow the sun on them lest cracking results.

The kilns are made of brick and square in plan, having a height of one to two times the length of side.

The elevation of the grate and floor upon which the bricks are laid for burning is 1 meter from foundation. This grate is in the form of an arch, and made of brick and clay.

The method of manufacture in this province is to close the kiln entirely except for a venthole at the top. After the bricks are stacked inside, the fire is burned moderately for five days when the heat is raised to burn the bricks at a red heat for two days, after which the fire dies out and the bricks are allowed to cool down for a week before removal.

The manufactured bricks are sold under two classifications, first and second. The dimensions of the first size are 0.22 by 0.11 by 0.06 meter and sell for about ₱10 per 1,000, while the second class are only half as thick and sell for ₱5 per 1,000.

Iloilo Province has two active brickmaking plants in operation that supply the Provinces of Iloilo, Antique, Capiz, Occidental Negros, and Oriental Negros with this material. The Javellana plant is situated on the Tigan River, 8 kilometers from Iloilo, and has been in operation for so many years that the present owners have no record of its beginning, while the Jallandoni plant is a modern one constructed in 1902 on the north side of the Iloilo River near the Forbes Bridge.

The methods of making brick are the same in both plants. The clay is taken from the fields adjacent to the plants and transported by horse, carabao, and tramway to a hole in the ground where water is added and the mass puddled to the right consistency, when it is carted to the combined molding and burning shed. The molding is done in wooden frames which are taken to a stamping and pressing machine for compressing. From here they pass to the drying pile for a fifteen to forty days' stay, dependent on weather conditions. From the drying pile they are placed in the kilns and burnt for eight or nine days, using wood fuel, and then allowed to cool down.

Each plant has two kilns, those of the Jallandoni plant having a capacity of 45,000 bricks each and those of the Javellana plant of 20,000 bricks each. It takes from a month to six weeks to make a brick at these plants, which are in operation all the time as the brick is sold as fast as manufactured.

One molder turns out 1,100 bricks a day. The daily labor wage at the Jallandoni plant is ₱0.50 (\$0.25), while the weekly wage at the Javellana plant is ₱1 (\$0.50) with subsistence.

In the Province of Isabela there were formerly several brickkilns in active operation which were operated by the friars, but these ceased operation in 1899. In this isolated province brick should prove the most economical building construction where permanence is considered.

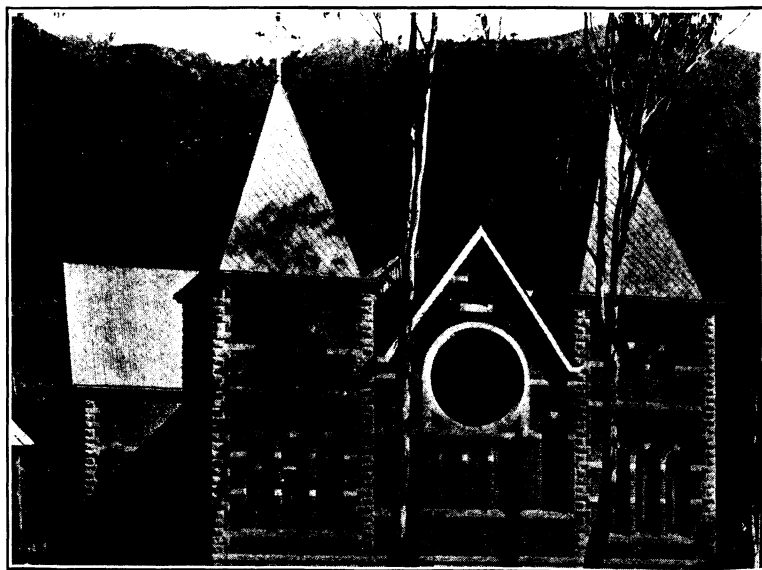
Rizal Province has probably the longest experience in brickmaking of any province in the Philippines.

In 1871 Colonel Cordova, a Spanish engineer, erected a unique kiln that purposed to improve the crude method in vogue previous to that period. This kiln was circular in shape with 12 radial compartments, each compartment having a capacity of 12,000 bricks. The main kiln is 20 meters in diameter with a 2-meter smokestack in the center. The long wrought-iron covers mark the divisions between compartments, and removable wrought-iron partitions are provided for those places. At the top of each compartment are small holes provided with caps for receiving the coal fuel, and each compartment has a vent. In burning, only alternate compartments were used. The cost of coal has become so high that this kiln has been superseded by single ones designed for wood fuel. With this above-mentioned plant there was also installed a modern pug mill and molding machine connected to a steam engine. To-day this work is done by depositing the raw material in a sink hole where it is worked by carabao driven around by man.

The present Visara plant has a capacity of 12,000 bricks a week and employs about 15 men. Three classes of soft bricks are manufactured—a plain brick 2 by 4 by 8 inches in size, a tongue and groove brick at the ends, and a plain brick with four holes through the side.

The material from the crude pug mill is carried to the shed where it is molded by hand. In preparing the wooden form, ashes are rubbed next to the wood to prevent adhesion, the molder slaps in the plastic material and presses same, the excess material is cut off, and the formed bricks are carried to the drying room where they stay from five to ten days. When dried, the bricks are loaded into the kiln and burned for thirty days, consuming 45 talaksanes (about same number of cords) of wood. One molder makes from 650 to 700 bricks a day at this plant.

From 1890 to 1892, in Sorsogon Province, there was one brickkiln for the church and convent at Pilar. This kiln, also the church and convent, was designed by the Catholic Father Mateo Atienza, and had a capacity of 2,000 bricks at one burning, which took twelve days.



Roman Catholic Church made of bricks by Bontoc Igorots, Bontoc, Bontoc.

At the present time there are no known brickkilns in existence, though material is plentiful in this province.

The brick plants above mentioned, though not including all the plants of the Philippine Islands, show how widespread is brick

material in the Philippines and also how crude the methods employed as compared to the modern methods as described above.

The bricks manufactured from these crude plants can serve only for such construction that take little or no hard service, while the brick manufactured in the States serves practically every construction and has become the one road material that seems to fulfill every condition if properly made and laid.

BRICK PAVEMENTS IN THE UNITED STATES.

Vitrified brick was originally confined to city street construction but, due to lack of care in the manufacture of the brick and in the construction, very few of the early pavements proved satisfactory. After forty years' experience, however, it has been found feasible to manufacture vitrified bricks and to construct pavements that are entirely successful, and from city pavements the construction has expanded to country highways of large mileage. Massachusetts has always been considered the leader in advanced highway work, but in the development of the brick pavement Ohio and Washington have been the States to show the way and the other States are rapidly coming into line. The principal advantages of the vitrified brick pavement are as follows: (1) They are durable under heavy traffic conditions; (2) they afford easy traction and good foothold for horses; (3) they are easily maintained and kept clean; and (4) they present a very pleasing appearance.

The principal disadvantage is the high first cost, but this is an economy if the best quality of brick is used and the work is done in strict accordance with modern specifications.

The physical characteristics of a good paving brick, the methods of testing, and the construction of country roads with vitrified bricks as given in Bulletin 23 of the Department of Agriculture is here shown for guidance:

Paving brick should be uniform in size, reasonably perfect in shape, and free from ragging, due to friction in the die, or kiln marks, caused by impressions from overlying brick in burning. They should be tough in order to resist crushing, hard in order to resist abrasion, and uniformly graded in order that the pavement may wear evenly. Each brick should be homogeneous in texture and free from objectionable laminations or seams. Fire cracks, caused by too rapid firing, should be limited in number and extent, and the entire brick should be vitrified and should contain neither unfused nor glassy spots.

The color is a valuable guide in inspecting brick from the same plant, but it is of little importance when the brick to be compared are from different factories. For brick manufactured from a particular raw material the color indicates, in a measure, the temperature to which they have been subjected, provided they have been burned under identical conditions. Ordinarily, the darker the color, the higher the temperature and, presumably, the better the brick. The surface color of brick may be very misleading, however, and the color of the interior should be used in making comparisons.

The specific gravity of paving brick was formerly considered of importance in judging their fitness for use in pavements. It has since been generally conceded, however, that a knowledge of the specific gravity is of comparatively little value. The specific gravity of shale brick is ordinarily between 2.20 and 2.40, and of fire-clay brick between 2.10 and 2.25.

The absorptive power of brick, like their color, is a matter of very light importance, except for comparing specimens manufactured under identical conditions. It is true that the porosity of the brick increases with the power of absorption, but it is very doubtful if any paving brick possessing an objectionably high absorptive power could pass even a very casual inspection. In other words, a high degree of porosity always manifests itself in other ways more clearly than in the ability of the brick to absorb water.

The crushing strength of good paving brick varies from 10,000 pounds to 20,000 pounds per square inch when the load is applied uniformly over the entire top surface of the test specimen, and may be much greater if the area over which the load is applied is less than that of the top surface. Since paving brick in use are seldom required to withstand a pressure of more than about 2,000 pounds per square inch and since inferior brick may possess relatively very high resistance to crushing, a knowledge of the crushing strength is clearly of little value in comparing the relative excellence of different makes of brick. It is, therefore, usually considered unnecessary to specify a definite requirement as to the crushing strength of paving brick.

Definite methods of testing paving brick have been in general use for only a comparatively few years and have only recently undergone a pronounced change. The object of all tests is to determine whether or not a given quality of brick is suitable for use in constructing pavements and to furnish a basis for comparing different classes of brick. The methods have, therefore, been repeatedly changed, not only in order to make the results obtained indicate more definitely

the quality of the brick, but also with a view to establishing uniformity, so that results obtained in different laboratories may be intelligently compared. A discussion of the most important tests follows in more or less detail.

The general appearance of a paving brick is, to an experienced eye, a valuable indication of its quality, and will frequently suggest the advisability of applying routine tests to some particular part of a shipment. Unfortunately, however, the knowledge gained from experience with one kind of brick can not be safely relied upon in inspecting other brick made by a different process or from a different class of raw material. A further limitation to this method of testing lies in the fact that the results obtained do not admit of numerical evaluation, and cannot, therefore, be very accurately described. This test is nevertheless valuable, and since no apparatus other than a hand hammer is needed, it can always be employed.

The test consists simply in making a careful inspection of the brick individually and collectively. The size is tested by making measurements, the shape by arranging a number of brick in the order in which they are intended to be placed, and the quality by an examination of both the exterior and interior of a number of samples.

The transverse strength of brick is determined by supporting it upon two knife edges and applying a load on the opposite side and midway between the supports by means of a third knife edge. The load is gradually increased until rupture occurs, and the result of the test is expressed in terms of the ratio $\frac{3Pl}{2bd^2}$, called the modulus of rupture. In the above ratio P represents the breaking load in pounds, while l , and d represent, respectively, the distance between supports, the breadth of the specimen, and the depth of the specimen, all measured in inches.

The modulus of rupture for good paving brick usually lies between 2,000 and 3,000, and frequently varies considerably even with carefully selected specimens which have been manufactured under identical conditions. In making this test a considerable number of specimens should be used, and the requirements concerning the transverse strength should be no less definite as to uniformity in the results of the test than as to the average modulus of rupture.

The rattler or abrasion test is undoubtedly the most important of the tests made on paving bricks at present. In making this test the specimen brick are subjected to destructive influences very similar to those encountered in actual service, and the results obtained, therefore, indicate very closely the effect which the traffic may be expected to produce on a pavement constructed of similar brick. The methods of making the test, of which there were formerly a great many, have undergone repeated changes in order that service conditions may be more nearly approached and also in an effort to bring about uniformity, so that the results obtained may be of the greatest possible scientific value. The method which has been lately recommended by the subcommittee on paving brick of the American Society for Testing Materials may be briefly described as follows:

"The apparatus necessary for making the test, ordinarily called the rattler, consists of a 14-sided barrel of regular polygonal cross section supported on a suitable frame and fitted with the necessary driving mechanism. The staves, each of which forms a side of the barrel, are made of 6-inch 15.5-pound structural steel channels 27½ inches long. These staves are double bolted to the cast-iron heads of the barrel, which are provided with slotted flanges for holding the bolts. Cast-iron wear plates are bolted to the inside of the barrel heads. The outside diameter of the barrel is 28½ inches.

"In this barrel is placed what is known as the abrasive charge. This charge consists of two sizes of cast-iron spheres having respective diameters of 3½ inches and 1½ inches and weighing, respectively, 7.5 pounds and 0.95 pound when new. Ten of the larger spheres are used, and the number of the smaller spheres is made such that the weight of the entire charge will approximate 300 pounds. The individual larger spheres are discarded whenever their weight falls to 7 pounds or less and the smaller spheres when they become sufficiently worn by usage to pass through a circular opening having a diameter of 1½ inches.

"The test is made by placing a charge of 10 representative brick, which have been previously dried at a temperature of 100° F. for at least three hours, in the barrel together with the abrasive charge, and then revolving the rattler 1,800 times. The number of revolutions per minute is not permitted to fall below 29½ nor to exceed 30½, and the operation is made continuous from start to finish.

"The results of the test are reckoned in terms of the loss in weight sustained by the brick, and this loss is expressed as a percentage of the original weight of the brick tested. In determining the loss in weight, no piece of brick which weighs less than 1 pound is considered as having withstood the test.

"Good paving brick will ordinarily lose from 17 to 22 per cent of their original weight in the rattler test, and specifications concerning this loss should be prepared with a view to the character of the traffic for which the pavement is designed. Some reasonable requirement as to the loss sustained by any individual brick should also be made. This loss should ordinarily not exceed 25 per cent, and under severe traffic conditions a smaller percentage should be required.

"In forming a roadbed upon which a brick pavement is to be constructed, the essential features to be considered are (1) thorough

drainage, (2) firmness, (3) uniformity in grade and cross section, and (4) adequate shoulders."

Thorough drainage can be secured for any particular road only by means of a careful study of the local conditions which affect the accumulation and "run-off" of both the surface and ground water. These conditions vary considerably even in the same locality, and no set of rules can be given which would cover all cases. For example, the material composing the roadbed may be springy, and in this case tile underdrains will probably be necessary. On the other hand, extremely flat topography may make it necessary to elevate the grade considerably above the surrounding land. The nature of the soil, the topography, and the rainfall must all be considered if a system of drainage is to be planned properly.

The second requirement, firmness, can be secured only after the road has been properly drained. Soils which readily absorb moisture can not be properly drained in wet weather and should not be permitted to form a part of the subgrade. In order that the subgrade

the pavement is being laid and rolled. The shoulders should never be less than 4 feet wide and should consist of some material which compacts readily under the roller and which does not readily absorb water. Not infrequently one of the shoulders is made sufficiently wide to form an earth roadway parallel to the brick pavement. Such an arrangement serves to relieve the pavement of considerable traffic during favorable seasons and thereby adds greatly to its life. The general method of constructing shoulders for brick roads is not essentially different from that employed for other types of pavements.

All brick pavements should be supplied with strong, durable curbing, both on the sides and at the ends. Otherwise, the marginal brick will soon become displaced by the action of traffic, and their displacement will of course expose the brick next adjoining, so that deterioration will soon spread over the entire pavement. Properly constructed curbing, on the other hand, will hold the pavement as in a frame and enable the brick to present their combined resistance to the destructive influences of traffic.



Rolling sand cushion before placing brick pavement, Chevy Chase Road, Washington, D. C.

may be unyielding, it is also necessary that the roadbed be thoroughly compacted. In forming embankments, the material should be put down in layers not over 8 inches thick, and each layer should be thoroughly rolled. In excavation care should be exercised, if the material is earth, not to permit plows or scrapers to penetrate below the subgrade. The subgrade in both excavation and embankment should be brought to its final shape by means of finish grading with picks and shovels and rolling.

When completed, the subgrade should be uniform in grade and cross section, or otherwise the foundation must be made unnecessarily thick where depressions occur, in order that its grade and cross section may be uniform and its thickness not less at any point than that required. The subgrade should be repeatedly rolled and reshaped until the desired shape is secured. The curbs, which should be set before the final finishing, may be made to serve as a guide for this work.

The shoulders, while essentially a part of the road surface, should be constructed at the same time that the subgrade is formed. This is necessary in order that the curb may be properly supported while

Satisfactory curbs may be constructed of stone, Portland cement concrete, or vitrified clay shapes made especially for this purpose. Wood has also been used for curbs to a limited extent, but when it is considered that the life of a brick pavement under ordinary conditions should far exceed the life of any wood curb which might be devised, the economy of employing a more durable material is readily apparent.

Stone curbing may be made from any hard, tough stone which is sufficiently homogeneous and free from seams to admit being quarried into blocks not less than 4 feet long, 5 inches thick, and 18 inches deep. On account of their ordinarily homogeneous structure, granite and sandstone are probably more used for curbs than any other kind of stone.

All stone curbing should be hauled, distributed, and set before the subgrade is completed. The individual blocks should be not less than 4 feet long except at closures, and should have a depth of from 18 to 36 inches, depending on traffic conditions and on whether the curb is to project above the surface forming one side of the gutter. The

neat thickness need never be greater than 6 inches and, where the traffic conditions are not severe and the quality of the stone is good, a thickness of 4 inches will ordinarily prove satisfactory. Stone curb should always be set on a firm bed of gravel, slag, or broken stone, not less than 3 inches thick, and should be provided with a backing of the same material on the shoulder or sidewalk side.

Where suitable stone is not readily available or when from any cause the cost of stone curbing would prove excessive, a curb constructed of Portland cement concrete may frequently be advantageously used. Concrete curbs may be constructed alone or in combination with either a concrete gutter or a concrete foundation. The advisability of constructing the curb in combination with the foundation, however, is doubtful. Very little is saved by such an arrangement, and the small saving is probably even more than offset by the additional difficulty involved in preparing the subgrade without the curb to serve as a guide. Concrete curbs should have approximately the same cross-sectional dimensions as stone curbs and should be constructed in sections not exceeding about 7 or 8 feet in length.

and pavements constructed upon foundations of this kind, ordinarily called "double-layer" pavements, have in general proved satisfactory, even where the subgrade was composed of an inferior material. At the present time, however, such foundations can rarely be constructed at less cost than the more durable concrete foundations, and they will therefore be given no further consideration here.

Gravel and broken-stone foundations may be spread in one or more courses, each of which should be from 5 to 9 inches thick before compacting. The materials used should conform in the matter of physical characteristics to the ordinary requirements for similar materials used in constructing macadam roads—that is, the stone or gravel should be clean, hard, tough, and durable, and should be graded in size between certain reasonable, fixed limits. It should be uniformly spread on the road, either from dumping boards by means of shovels or from wagons especially designed to spread the material as it is being dumped. Where whole loads are dumped in one place and then spread out to the required depth, it is very difficult to obtain uniform density. Usually those spots where the loads are dumped are more



Brick pavement in place on Chevy Chase Road, Washington, D. C.

A firm, unyielding foundation is one of the most essential features of a brick pavement. This fact can be more readily appreciated when it is considered that the surface of a brick pavement is made up of small individual blocks, any one of which might be easily forced down, causing unevenness in the surface, if the foundation were poor; and since the ability of the pavement to resist wear depends very largely on the smoothness of the surface, every reasonable precaution should be taken to prevent any unevenness from developing.

The proper type of foundation depends largely on the material composing the subgrade and character of traffic for which the road is designed. Where the traffic is comparatively light and the subgrade is composed of some firm material which does not readily absorb water, a very satisfactory foundation may be constructed of broken stone or gravel filled with sand. Where the traffic is comparatively heavy, however, or where the material composing the subgrade is defective in any way, a monolithic concrete foundation should be used. Foundations consisting of a course of brick laid flat upon a previously compacted layer of gravel or broken stone have also been extensively used,

densely compacted than the rest of the foundation, and this lack of uniformity very soon manifests itself by producing unevenness in the surface of the pavement. Broken stone and gravel foundations should be compacted in the usual manner by rolling with a power roller weighing not less than about 10 tons, and sufficient clean, coarse sand to fill the voids should be spread and flushed into the foundation while the rolling is in progress. When complete, the foundation should present a surface uniform in grade and cross section and parallel to the proposed surface of the finished pavement.

Concrete foundations are unquestionably better adapted for brick pavements than any other type. They are practically monolithic in form, nearly impervious to water, and possess a relatively high crushing strength. All of these qualities may be obtained with a relatively "lean" concrete if the subgrade has been properly prepared. Under ordinary circumstances a satisfactory foundation may be constructed of concrete composed of 1 part of Portland cement, 3 parts of sand, and from 5 to 7 parts of broken stone or screened gravel.

The sand should be clean and well graded in size, and the stone or

gravel should conform to the requirements given above in connection with the discussion of foundations constructed of those materials.

Foundations for brick pavements have also been constructed of timber boards laid on sand, and in some instances of sand alone. These foundations have seldom proved satisfactory for any great length of time, however, and can, therefore, be economically used only when the pavement is to be constructed of an inferior grade of brick.

Since it is practically impossible to construct an absolutely smooth foundation, and since there is always a slight variation in the size of paving brick, owing to slight differences in the amount of shrinkage at the time of burning, it is necessary to provide an adjustable cushion of some kind between the foundation and the brick for correcting these slight irregularities, in order to secure an even surface and an uniform bearing for the brick. Sand has been found a most satisfactory material of which to construct this cushion, and is almost exclusively used for this purpose. The proper thickness for the sand cushion will, of course, depend on the extent of the inequalities above

the cross section of the finished pavement. The length of the template is ordinarily made equal to the width of the pavement where this is less than about 25 feet, and equal to half the width for wider pavements. Timber guides may be laid in the same direction as the pavement for the template to slide on, or the curbs may be made to serve as guides where this is convenient.

After the cushion is spread and uniformly "struck off" with the template to a depth slightly in excess of that required, it should be thoroughly compacted by rolling with a hand roller weighing from 300 to 400 pounds, and any depressions which form should be corrected. This is necessary in order to secure uniform density and to prevent unequal settlement of the surface.

The brick may all be hauled and piled at convenient intervals along the sides of the roadway before grading is begun, or, if more convenient, they may be delivered as needed on the work. Hauling over the finished pavement with wagons until it is complete and open to traffic should be avoided. If the brick are delivered on the work as



Spreading sand cushion on concrete base preparatory to laying brick, Chevy Chase Road, Washington, D. C.

mentioned. Two inches is the most usual thickness, however, and this thickness has generally proved very satisfactory.

The sand used in the cushion should be clean, free from pebbles, and preferably fine grained. If dirt or vegetable matter is present, it will soon be leached out and cause unevenness to develop in the pavement, while pebbles prevent the brick from securing a uniform bearing, and ultimately produce the same result. Fine sand adjusts itself to the shape of the brick more readily than coarse sand, and is, therefore, given preference. It is also important that the sand should be dry when spread, because a comparatively small amount of moisture increases the volume of fine sand considerably, and moisture when present is not, as a rule, uniformly distributed. Even if it were uniformly distributed at the start, some spots would dry out more rapidly than others while the spreading was under way, and a lack of uniformity would thus be produced in the cushion.

In forming the cushion the sand is uniformly spread over the foundation to a depth slightly in excess of that desired, and is then smoothed off by drawing over it a template shaped to conform with

needed, they should be unloaded from the wagons outside of the curb and carried to the pavers, either by hand or wheelbarrows. Plank trackways should also be provided over the newly laid pavement for the wheelbarrows when they are used.

The brick should in all cases be uniformly piled by hand on the new pavement conveniently close for the pavers, and each should be so placed that the regular operation of picking it up and placing it in the pavement will bring the best edge up. This method of hauling the brick requires somewhat more labor than the common method of dumping them from wheelbarrows, but it eliminates to a great extent the practice of picking out and turning over chipped or kiln-marked brick, after the pavement is laid. This is very objectionable on account of the disarrangement of the sand cushion, which is frequently occasioned.

The brick should be laid on edge and in uniform courses running at right angles to the line of the pavement, except at intersections; and in order to "break the joints" each alternate course should begin with a half brick. In laying the brick the pavers stand on the

pavement already laid and, beginning at the curb each time, carry across as many courses together as they can conveniently reach. The courses should be kept straight and close together, and, if necessary, each block of 8 or 10 courses should be driven back by means of a sledge and a piece of straight timber approximately 2 by 4 inches by 5 or 6 feet long. The brick should also be laid close in the courses and should be crowded together, if necessary, after a course is laid, by means of a crowbar inserted at the curb.

After the brick are laid, the pavement should be carefully inspected for the purpose of detecting soft or otherwise defective brick. Misshapen or broken brick may be detected by the eye alone and the soft brick by sprinkling the pavement with water. The soft brick appear comparatively dry while the water is being applied and comparatively wet after the sprinkling is stopped. All defective brick should, of course, be replaced by others which meet the requirements of the specifications.

After the pavement has been laid and all defective brick has been

blows of the rammer should not fall directly upon the brick, but should be transmitted through a 2-inch board laid parallel to the curb.

After the pavement has been trued up, as described above, it should be inspected again for broken or otherwise damaged brick, and also for those which have settled excessively, owing to some lack of uniformity in the sand cushion. All defects should be corrected and the areas disturbed in making the corrections should be brought to a true surface by tamping.

In order to keep the brick in a proper position and protect the edges from chipping, it is necessary to fill the joints with some suitable material before the road is opened to traffic. The materials which have in the past been most commonly used for this purpose are sand, various bituminous preparations, and a grout made of equal parts of Portland cement and fine sand mixed with water.

Sand is the least expensive of these materials, but there are several very serious objections to its use as a joint filler: (1) It does not protect the edges of the brick; (2) it is easily disturbed in clean-



Grouting brick pavement after brick surface has been compacted in place, Chevy Chase Road, Washington, D. C.

replaced to the satisfaction of the engineer, the next step is to sweep the surface clean and smooth out all inequalities by means of ramming or rolling. The rolling should be done with a power roller weighing from 3 to 5 tons, and the pavement should ordinarily be rolled in both the longitudinal and transverse directions. The longitudinal rolling should be done first and should begin at the curbs and progress toward the crown. The roller should pass at least twice over every part of the pavement in both transverse and longitudinal directions. In order to neutralize any tendency which the brick may have to careen under the roller, the number of forward trips over any part of the pavement, if more than two trips are required, should equal the number of trips backward over the same part.

In places where it is impracticable to use the roller for truing the surface, such, for example, as along the curbs or concrete gutters or around manholes, the brick should be brought to a true surface by means of ramming. For this purpose a wooden rammer loaded with lead and weighing from 80 to 100 pounds may be used. The

ing the pavement and is likely to be washed out by rain on steep grades; (3) it does not entirely prevent water from penetrating through to the foundation; and (4) it does not bond the individual brick together, and so enable them to present a concerted resistance to traffic.

The bituminous fillers vary considerably in quality and efficiency, but all are more or less unsatisfactory. One of the principal objections to their use is based on their tendency to run out of the joints into the gutters during warm weather and to crack and spall out during cold weather. This tendency can, of course, be partially overcome by exercising proper care in selecting the materials. It should also be noted in their favor that brick pavements, the joints of which have been filled with bituminous preparations, are ordinarily less noisy at first than those where a Portland cement grout filler has been used. The grout filler is unquestionably very much superior from a standpoint of durability, however, and the excessive noise under traffic which has been frequently observed in connection with its use can be largely eliminated by the use of proper bituminous expan-

sion cushions along the curbs. It is, therefore, recommended as better adapted for filling the joints in the brick pavements than any other material which has been commonly used for that purpose.

When the joints of a brick pavement are properly filled with Portland cement grout, the individual brick are firmly bonded together and the pavement is thereby practically converted into a monolith. Moreover, since the material composing the joints scarcely wears more rapidly than the brick, the edges of the brick are well protected, and the importance of this feature has already been pointed out.

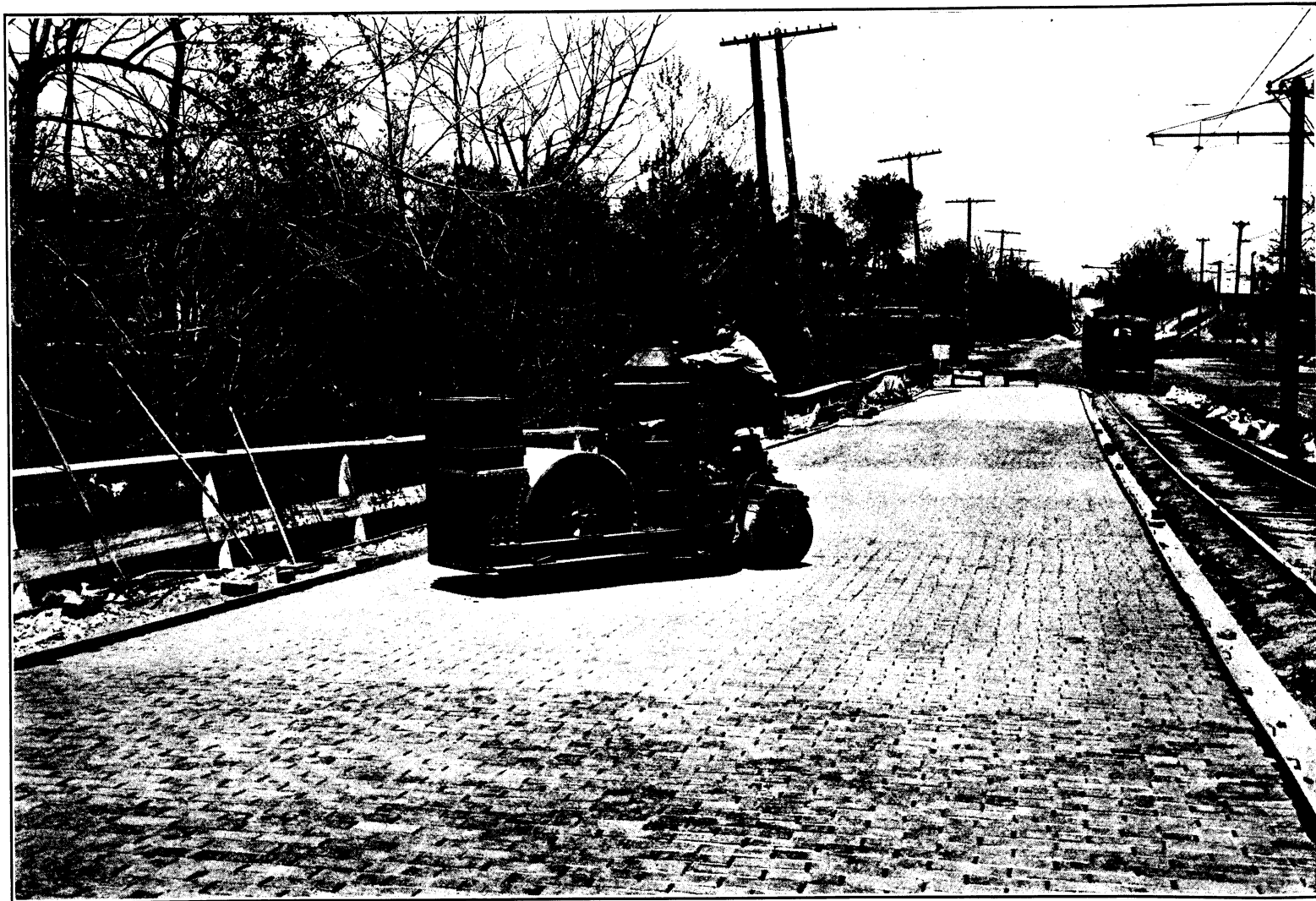
The most satisfactory method yet devised for mixing and applying the grout filler may be described as follows: Grout boxes constructed in such manner that, when resting on a level platform, one corner will be lower than the others should first be provided. The number of boxes required depends on the width of the pavement; ordinarily one box to each 10 feet of width will be found sufficient. The grout, which should be put on in two applications, is prepared in batches each of which consists of a quantity of cement not exceeding one sack, a like amount of fine, clean sand, and water. The sand and cement should

the second. Usually both applications are made by the same crew of laborers. They simply turn back after having covered the allowable distance with the first application and, mixing the grout in the same boxes, bring up the second application. The second application of grout should completely fill the joints flush with the top of the brick.

After the joints are filled as described above and the grout has taken its initial set, the entire surface should be covered to a depth of approximately one-half inch with clean sand. This is done to protect the pavement from the weather and to keep it in a moist condition while the grout is hardening. If necessary, in order to keep the sand moist, it should be occasionally sprinkled for several days after it is spread.

The sand covering should be permitted to remain on the surface for at least ten days, and during this period the pavement should be kept entirely closed to traffic. If the weather is unfavorable, the length of time during which traffic is kept off the road should be increased.

It has been customary in the past to provide both longitudinal and



Rolling brick before grouting on Chevy Chase Road, Washington, D. C.

first be thoroughly mixed dry and sufficient water then admixed to produce a liquid mixture. The consistency of the mixture for the first application should be approximately the same as that of thin cream, and for the second application it should be somewhat thicker.

The pavement should be clean and thoroughly sprinkled as a preliminary to making the first application of grout, and it should be kept moist by gentle sprinkling while this application is being made. The grout should be removed from the boxes and spread upon the pavement by means of scoop shovels, and it should be immediately swept into the joints. For this purpose a coarse rattan or fiber push broom should be used in the first application, and a squeegee in the second application. The squeegee is made by clamping a piece of four-ply rubber belting or some other similar material, about 6 by 20 inches in size, between two pieces of board and attaching a suitable handle. The grout in the boxes should be continually stirred until the last shovelful is removed, otherwise a separation of the sand and cement will almost certainly occur.

The first application should proceed about 50 feet in advance of

transverse bituminous expansion cushions in grout-filled brick pavements, but recent practice has demonstrated that the transverse cushions may be advantageously omitted if proper longitudinal cushions are provided. The principal objection to the use of transverse expansion cushions is based on the fact that the material composing the cushions frequently softens during warm weather and runs out toward the curb, thus leaving the edges of the adjoining brick exposed to destructive impact from the wheels of passing vehicles. Even if the cushion consisted of a material which does not run in warm weather, it is necessarily softer than the brick, and the natural result is still the development of unevenness in its immediate vicinity. No such objection can exist concerning longitudinal expansion cushions, however, if they are placed adjacent to the curbs and constructed of proper material. They not only furnish a means for the pavement to expand and contract with changes in temperature but they also eliminate to a large extent the disagreeable rumbling which has been so frequently associated with grout-filled brick pavements.

The bituminous material of which the expansion cushions are made

should be such as to remain firm in summer and not to become brittle in winter. It should also possess the quality of durability. In order to insure that any given material is suited for such a purpose, it is usually considered necessary to prescribe certain laboratory requirements to which it must conform.

Expansion cushions should be provided for at the time the brick are laid, by placing a board of the required thickness on edge adjacent to each curb. Small iron wedges may be inserted between the curb and the board at the time the board is set. These wedges may be readily loosened and removed after the bricks have been laid and grouted, and may consequently be made to facilitate the removal of the board.

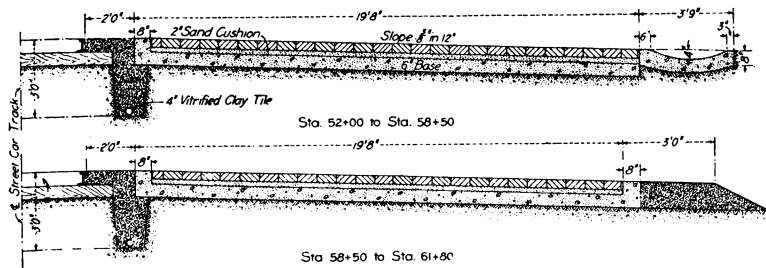
The proper thickness for expansion cushions is a matter concerning which much difference of opinion exists among highway engineers. Some engineers advocate a minimum thickness of 1 inch, while others claim to have secured their best results by using expansion cushions having a minimum thickness as low as three-eighths inch for very narrow pavements. It is generally agreed, however, that the thickness of the cushion should vary with the width of the pavement. The following are suggestions for proportioning as being fairly representative of the best practice:

Width of roadway (feet).	Thickness of cushion.
	Inches.
20 or less	1
20 to 30	1 1/2
30 to 40	1 1/2
Over 40	1 1/2

It seems to be the consensus of opinion that a concrete base is necessary for a brick pavement, though there are sections where successful brick pavements are being constructed without the concrete base, as in Florida, where the ground is sandy. Here they excavate the loose top sand and carefully compress the subgrade upon which the brick is laid without the necessity for a concrete base.

The thickness of the concrete base varies in different parts of the country from 4 to 6 inches.

The writer had the pleasure of going over the 1,884 meters of experimental pavement on Chevy Chase Road, Maryland, with Mr. J. T. Voshell, U. S. senior highway engineer, Office of Public Roads, Washington, who conducted this experiment to determine the relative values of several more or less standard pavements and of various road-building materials. The vitrified brick pavement was 300 meters in length and of cross section shown herewith:



Cross-section of experimental brick road on concrete foundation.

The curb shown in section was adopted both for economy and for convenience to traffic. Forms were set on the outer edge of the curb line with the top edge 6 inches above the proposed top surface of the base. As soon as the base concrete was laid, the inner forms for the curb were set and the curb concrete tamped in place. The curb concrete was 1:1 1/2:3 mixture and the curb cost was \$0.162 a lineal foot.

Cost of brick roads in King County, State of Washington.

Road.	Location.	Ready for traffic.	Base.	Width.	Brick.	Length.	Contract price, including grading.	Cost per mile.
				Ft. in.		Miles.		
Kent	South of Kent	Spring, 1913	5-inch concrete	16 10	No. 2 brick	2.90	\$58,750	\$20,258
Puyallup	Puyallup	do	4-inch concrete	16	do	.75	18,000	24,000
Kittitas County	Ellensburg	Summer, 1913	do	16 10	do	1.18	23,500	19,906
Snohomish County	Stanwood	Autumn, 1913	6-inch concrete	18 10	do	1.00	25,330	25,330
South Trunk	Auburn	do	5-inch concrete	20 10	Highway block	3.00	87,500	29,167
Bothell Road	Bothell	Early in 1914	do	18 10	Highway brick	3.33	84,000	25,229
North Trunk	North 85th Street	do	do	18 10	do	6.13	149,750	24,429
Meadows	South city limits	October, 1913	Macadam	20 10	do	.20		*17,428

* Estimated.

The concrete base was 6 inches thick and made with a 1:3:6 mixture.

The sand cushion was 2 inches in thickness and rolled with a 300-pound lawn roller, after which the surface was sprinkled with the sand for a quarter inch depth and again screened and rolled.

For the pavement, 14 varieties of brick furnished by the different manufacturers were used. The brick were laid in straight courses at right angles to the curb and were rolled with a 5-ton tandem roller until firmly embedded in the sand cushion, after which a cement grout of 1 part cement and 1 part sand was poured into the joints. On top of this a thick grout was squeegeed over the whole pavement, leaving all the joints completely filled. A half-inch layer of sand was spread on top and kept wet for seven days. No transverse expansion joints were used, but a longitudinal one filled with a mixture of coal tar and cement mixed at a 250° F. temperature was placed alongside the curb.

The cost of this work for the section was \$12,204.02, or approximately \$43,000 a kilometer.

In the construction of country roads in the Middle West, Cuyahoga County, Ohio, has taken the lead. A list of the roads constructed with typical cross sections and cost is given herewith:

Brick roads without concrete base in Cuyahoga County, Ohio.

Name of road.	Stone curbs.	Base used.	Width.	Length.	Total cost per mile.	Completed.
	Inches.		Feet.	Miles.		
Bedford	Bk. 6	Slag	16	6.02	\$21,484	Feb. 9, 1907
Berea	6	do	16	1.53	28,286	Nov. 20, 1907
Do	6	do	14	3.46	18,970	
Brecksville:						
No. 1	6	Broken stone	14	6.40	19,290	Nov. 20, 1907
No. 2	6	do	14	2.66	22,697	June 1, 1908
Coe Ridge	6	do	16	8.72	20,597	Nov. 6, 1908
Kinsman, No. 2	6	Slag	14	3.83	20,143	Nov. 12, 1908
Lorain	6	do	16	3.68	15,793	
Miles Avenue:						
No. 1	6	do	40	1.59	34,580	Sep. 1, 1908
No. 2	6	do	15	2.78	25,603	Nov. 27, 1903
Noble	6	Broken stone	12	2.37	22,861	Dec. 16, 1907
Northfield	6	do	24	0.72	17,561	
North Ridge:						
No. 1	6	do	14	2.33	25,791	Sept. 18, 1905
No. 2	6	do	14	5.11	18,257	July 8, 1908
Prospect	6	do	14	1.58	23,259	Dec. 23, 1907
River, No. 1	6	Slag	16	0.49	18,797	Oct. 1, 1904
South Woodland	6	Broken stone	8	3.00	12,423	1895
Do	6	do	8	0.49	9,769	
West Madison	6	do	14	2.68	21,086	1903
Wooster, No. 1	6	do	14	1.33	27,340	Nov. 11, 1908
Wooster Pike	6	do	8	7.93	11,269	1895
Total miles of pavement				69.36		

The State of Washington leads the western part of the United States in the construction of country roads of vitrified brick, King County taking the initiative. Vitrified brick pavements have been in constant use in Tacoma and Seattle for many years, and the writer inspected one pavement that he saw constructed in 1898 (thirteen years afterwards), and believes it will last another thirteen years without question.

In 1912 the State legislature approved the sale of \$3,000,000 worth of bonds for vitrified-brick trunk roads for King County. These roads were already under construction or constructed when the writer inspected them. All contracts were let with a five-year guaranty, which was designed chiefly to protect the pavement from inferior workmanship in foundation base or grouting. A list of roads contracted for and the prices for which they were let follows:

In the United States the cost of vitrified brick at the kiln is from \$12 to \$14 per 1,000, and it takes from 40 to 45 ordinary bricks for a square yard of surface. The cost of grading, shaping, rolling, curbing, foundations, and transportation differs with locality of work. A paver and five laborers can lay approximately 220 square yards of brick in a ten-hour day. The cost of a 5-meter brick pavement per mile complete will vary from \$18,000 to \$25,000.

In the Northwest the vitrified block weighing 10 pounds each is superseding the standard vitrified paver because of the lesser number of joints in construction and exposed to traffic wear.

The best known brick of the West is made by the Denny-Renton Clay and Coal Company of Seattle, Washington. The sizes of their pavers and blocks with their 1913 price f. o. b. steamer are herewith given:

Kind of brick.	Approximate size and weight.	Price per 1,000.
Standard paving brick	8 $\frac{3}{4}$ by 2 $\frac{3}{4}$ by 4 inches, 7 pounds each	\$20.00
Bull-nose paving brick	8 $\frac{3}{4}$ by 2 $\frac{3}{4}$ by 4 inches, 7 pounds each	21.00
Rail-shape paving brick	8 $\frac{3}{4}$ by 2 $\frac{3}{4}$ by 4 inches, 6 $\frac{1}{2}$ pounds each	22.00
Standard paving blocks	3 $\frac{1}{2}$ by 8 $\frac{3}{4}$ by 4 inches, 10 pounds each	30.50
Bull-nose paving blocks	3 $\frac{1}{2}$ by 8 $\frac{3}{4}$ by 4 inches, 10 pounds each	31.50
Beveled paving blocks	3 $\frac{1}{2}$ by 8 $\frac{3}{4}$ by 4 inches, 10 pounds each	30.50

The freight rate from Seattle to Manila is \$6.25 a ton net weight uncrated, or about \$20 to \$30 per 1,000, which is prohibitive.

The Atlas Paving Brick Company of San Francisco quoted a 1913 price of \$35 per 1,000 on a 2 $\frac{1}{4}$ by 4 by 8 $\frac{1}{4}$ inches paving block f. o. b. steamer.

If brick pavements are properly constructed at the start, the work of maintaining them is very slight. Under the closest inspection, however, some inferior material is likely to become incorporated either in the foundation or in the surface, and it is, therefore, very important that a brick pavement be very carefully watched for the first few years of its life to see that no unevenness develops either because of defective bricks having been used in the surface or because of insufficient support from the foundation at any point. Whenever any unevenness develops, it should be immediately rectified. Otherwise, the pavement will become irregularly worn in the vicinity of the defects and expensive repairs will eventually be necessary.

Not infrequently weak spots develop in broken stone or gravel foundations, owing to surface water finding its way through joints in the pavement which have not been properly filled with grout. Careful observation of the joints should, therefore, constitute a part of the early maintenance work, and any defective joints discovered should be immediately remedied. Where the foundation is constructed of concrete, however, slight defects in the joints seldom result in any very serious damage.

If care is exercised to correct all defects which appear within the first few years of the life of a well-constructed brick pavement, the work of maintaining the pavement proper should thereafter, except for cleaning, be almost negligible. The shoulders and drainage structures, of course, need occasional attention, just as in the case of any other pavement, but if they are properly constructed at the start repairs will usually be very slight.

The life of a well-constructed brick pavement can not be estimated with any great degree of exactness, first, because the traffic conditions are constantly changing, and, second, because no brick pavement which has been constructed in accordance with the best modern practice has yet worn out. The amounts of wear sustained by given pavements during comparatively long periods of years have been determined in several instances, but have usually been so small as to make the probable terms of service appear almost indefinite. It is evident, however, that in order to secure the full benefit of this excellent resistance to wear the pavement must not be permitted to become uneven because of the failure of isolated bricks.

In the Philippines there are vast agricultural districts already opened and about to be opened where there is no rock of any nature for a permanent road construction. In these districts there has been tried sand, clay, gravel, coral, macadam, and even oiled roads, in many cases with indifferent results, costing from ₱5,000 to ₱18,000 a kilometer. Where rock for surfacing is available in the majority of cases it is not durable and necessitates replacing within three or four years at an expense of from ₱2,500 to ₱5,000 a kilometer.

The average maintenance of our first-class roads amounts to ₱500 a year, outside of the resurfacing cost every few years, of which about ₱200 goes in salary and the rest in material.

Sand and gravel as a rule abounds throughout the Islands at very reasonable prices and our concrete prices, in spite of the excessive cement cost, compare very favorably with prices in the States.

Clay we have in abundance as has been shown above.

Transportation as a rule is high, but labor at ₱0.50 to ₱1 a day for brick manufacture and for road work as compared with ₱3 to ₱6, as paid in the eastern and western parts of the United States, respectively, is a very important item to be considered.

Fuel in the shape of coal for burning is prohibitive in the Philippines at ₱12 to ₱16 a ton, but crude oil from Sumatra or Borneo for burning brick will decrease this heavy item of cost in the manufacture of brick.

A modern brick manufactory complete with crushers, pug mills, presses, etc., with a capacity of 50,000 bricks will cost to erect approximately ₱500,000. Such a plant will take about four days in handling material, about four days drying, eight days in burning, and six days in cooling, or twenty-two to twenty-four days for a batch to run through. Good vitrified brick with a modern plant should not cost as much as the inferior brick now turned out, or ₱16 to ₱20 per 1,000 at kiln.

With sand at ₱1 a cubic meter, gravel at ₱1.75 a cubic meter, and a cement at ₱7 a barrel, with average labor prices that prevail in the Philippines, a good 5-meter vitrified brick pavement with a 3-inch concrete subgrade (no frost condition here) for country road should cost:

2,000 meters of curbing, at ₱1 linear meter	₱2,000.00
5,000 meters of 3-inch concrete base, at ₱2.25	11,250.00
250 cubic meters of sand cushion, at ₱2 in place	500.00
250,000 bricks, at ₱0.03 in place	7,500.00
Grouting 5,000 square meters, at ₱0.20	1,000.00
Superintendence and miscellaneous, at ₱10 a square meter	5,000.00
Estimated cost per kilometer	27,250.00

Though this figure is high as compared to macadam and oiled roads, the lasting qualities of twenty to twenty-five years, as compared to the macadam or oiled roads, and the almost elimination of maintenance cost, are factors that have won out in the United States and must eventually in any country where the road system must be maintained at a high standard. In fact, the annual saving on maintenance cost per kilometer may be considered as interest on the difference in construction cost per kilometer between an oiled road with its short life and heavy annual maintenance cost and the vitrified brick road cost with its long life and small annual maintenance cost.

Credit is given to the following works and people for data used in article:

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 District Engineer R. V. Glenn, Iloilo, Iloilo Province.
 District Engineer R. Agcaoli, Laoag, Ilocos Norte.
 District Engineer E. E. Schenk, Pasig, Rizal Province.
 District Engineer J. L. Harrison, Malolos, Bulacan Province.
 District Engineer P. Gomez, Ilagan, Isabela Province.
 District Engineer H. B. Lilley, Sorsogon, Sorsogon Province.
 District Engineer L. W. Scheidemantel, Capiz, Capiz Province.

PLANS AND SPECIFICATIONS.

By W. H. WAUGH, Member American Society of Civil Engineers.

Most of the construction under the Bureau of Public Works is done after standard plans and specifications which have been carefully prepared by the different special divisions and which have been approved by superior authority. These plans and specifications are revised from time to time when improved methods are devised or where local requirements and conditions justify a change.

Perfection in plans and specifications is sought but, practically speaking, is unobtainable. In these days of swift progress, it is absolutely necessary to advance and improvements in standards and methods must be made whenever and wherever it is possible to make them. New ideas are always welcomed, but before they are adopted and put into general practice it is desirable and necessary to go fully into details and determine whether or not the new plan will actually work out satisfactorily on the ground. A great source of trouble on engineering work is that new ideas and methods are often inaugurated by men who have not had the necessary experience to know whether their plan would produce the result desired.

One of our strongest points is the progress made in the standardization of our work. In some instances changes have been made without authority which have produced a better and more satisfactory structure than would have resulted had the original plans or specifications been rigidly adhered to. In the majority of cases, however, changes when made without the necessary authority have resulted in work of a much lower standard than if the Bureau plans and specifications had been closely followed. In this respect, it is a significant fact that the best conditions in public work to-day are found in those provinces where the different district and division engineers have closely followed the plans, specifications, and instructions sent out by the central office. Although the standard plans, specifications, and instructions have undergone radical changes since the organization of the Bureau of Public Works several years ago, yet without exception, in those provinces where the engineers have not followed such instructions a much lower standard and inferior class of work is found. The above conditions are general and not confined to provinces of any particular size or class.

It has been charged that engineers require a much higher standard and better class of work from a contractor than they do for work done by administration. Such charges should have no foundation. An engineer has no more right to disregard or modify the specifications on administration work than he has to overlook specification requirements for work done under contract.

A man who disregards specifications and permits cheaper and inferior materials to be used, thereby gaining a reputation for doing work at a low cost, is not fair to his brother engineers who are conscientiously requiring that their work be done according to the rules of the construction game.

A little less cement here, a larger-sized rock there, and timber which is not up to requirements some place else, results in a cheaper structure, but it does not make one which will stand the test of time and use that the people who furnish the funds have a full right to expect. It is true that cement costs money, that it is expensive to break stone, and that proper timber is hard to get. However, the engineer and the contractor prepare estimates in detail on the cost of a certain project. Their figures are based on the detailed plans and specifications. They figure on a definite quantity of material of a certain specified quantity and quality. Each one is supposed to determine what these materials will cost him in place and the total cost of the completed structure. When the work is undertaken by either the contractor to build under contract or the engineer to construct by administration the specified materials and manner of doing the work is controlled by the plans and specifications. The requirements for both the engineer and the contractor are alike and equally binding. For the same structure the requirements as far as the plans and specifications are concerned are identical in all provinces.

There is no question but that it is much cheaper to lay a market floor in long monolithic slabs. Yet a floor laid in such a manner is sure to crack and become unserviceable when a slight settlement occurs. The specifications are very plain in regard to this feature and say "Concrete floors and sidewalks when supported directly on the ground shall be laid in alternate squares of about 1 meter, unless otherwise shown on plans." The next clause following is also highly important, but sometimes not given proper attention: "And the concrete shall be of such a consistency as to require tamping to bring the water to the surface." The writer has a case in mind when a 5-gallon gasoline can was filled with absolutely loose stone which was picked out of a single 1-meter square section of concrete floor,

most of the other squares on this job were almost as bad. This so-called concrete had been in place several hours and the finishing coat had not been applied. The specifications are not at all ambiguous and say: "They (the squares) shall then be finished with a wearing surface 0.02 meter thick of 1:3 mortar applied immediately after the concrete has been placed and before it has set." In the above case, that the concrete had not been properly mixed and of the necessary consistency is obvious. The concrete had been mixed too wet and was laid on a gravel foundation. The cement and sand simply ran off of the aggregate and sank into the gravel below. The thin wearing surface would have bound a few of the loose stones together, but the resultant material could hardly be recognized as concrete class A, B, C, or D.

The specifications for mixing concrete cannot be greatly improved. They are exceedingly simple and once a gang is thoroughly broken into proper mixing methods there should be little or no trouble from this source. One of the important details of mixing is the proportion and manner of applying the water. The proportion of water depends on the nature of the aggregate, the use to which the concrete is to be applied, and the ability of the foreman to determine the right consistency. It is also specified that "a spray or sprinkler shall be used. The water shall not be dashed upon the mass in buckets or in large quantities or by means of a jet." It undoubtedly takes more care and is more expensive to use a proper spray than to dash the water upon the mixture with a pail, but the first method results in an uniform mixture with a minimum of turning, while the second is likely, even with the most thorough mixing, to occasion uneven distribution of cement through the mass.

Reinforcing steel is not always as clean as it should be, yet according to specifications, "all steel shall be thoroughly cleaned of grease, scale, or foreign substances that may affect the adhesion of the concrete to the same." The value of reinforcing steel depends to a very large extent upon its adhesion to the concrete. Grease or scale completely destroys this adhesion, while dirt or other foreign matter (except, possibly, yellow rust, if in small quantities) weakens it. In all probability foreign material of the sorts enumerated will permit oxidation of the steel, which experience in the Philippines has demonstrated is a serious menace to the stability of reinforced-concrete work.

It is of the greatest importance that "all bars shall be placed true to the line and in the exact places as shown on the plans, and shall be so fastened that they will not be disturbed during the process of pouring concrete." Sometimes reinforcing bars are placed in footings and in forms in such a manner that they are moved by careless workmen or swayed by wind before the concrete has finally set. Special care should be exercised to see that the bars will actually not be disturbed or loosened during the progress of the work. Unless the steel is firmly embedded in the concrete it has no value whatever as reinforcement.

Another specification which is frequently disregarded is that prohibiting the use of salt water or beach sand in concrete. These specifications have a sound reason, in that salt is certain to discolor concrete surfaces. This should be a less serious matter, were the discoloration uniform, but such is not the case as inspection of many of our earlier structures will demonstrate. The only condition under which salt water may properly be used is where concrete must be poured in freezing weather—a condition never realized here. There is, further, a reasonable ground to suspect that salt, where present in concrete, promotes oxidation of the reinforcing steel or at least partially neutralizes the alkaline state of the concrete.

Another fruitful source of deterioration of structures is the manner in which the painting of structural steel is usually handled. The specifications provide that the steel shall be free from rust, scale, dirt, etc., and that the painting shall be done in dry weather. A rust inhibitive shop coat is specified. Yet some field engineers do not trouble to go over the steel after the erection and touch up those spots from which the shop paint may have been removed, nor the heads of field rivets. It is essential that these should be properly painted with the specified primer. Nor is the "dry weather" specification, as some construction engineers assume, a ridiculous one. The modern theory of corrosion is that it is due to electric action and

this depends upon the presence of water. Hence, if water be excluded the protection is practically perfect, provided a proper paint film be used.

It is false economy to save money by the employment of incompetent inspectors or to have an intermittent or spasmodic system of inspection. The cost of thorough inspection is a legitimate item of expense on any construction work and it is poor engineering to have inefficient or insufficient inspection. Not enough inspection is generally more costly in the end than to go to the other extreme where an unwarranted amount of inspection is provided. A good inspector can often look after more than a single piece of work, but care should be taken to see he is on the right job at the proper time. An inspector, to be an economic investment, must know the plans and specifications for the work under his direction. He must also know how to apply his instructions and to recognize at a glance whether work is being done in accordance with the plans and specifications. Plans and specifications are made and worded as plainly and as explicitly as possible, but it is not intended that they shall so cover the entire construction as to permit anyone able to read to build any class of structure. Previous training and experience is necessary for successful results. There are often times when the ideas of the designer and the constructor do not meet on a common plane. In such cases it is best to take the matter up with headquarters. If there is not time to do this, follow the plans and specifications. Especially should architectural details be followed faithfully. Their reasons may not always be clear to a layman, but the appearance of the finished job, in general, will justify them. On administration work, in particular, the constructing engineer, combining in himself the functions of inspector and contractor, should guard against unauthorized change of details as carefully as against inferior materials or workmanship.

On a purely structural question, a *reasonable* latitude is allowable; but where a pronounced change is considered, it should be taken up with headquarters. There is no excuse for work which violates the principles of good construction, especially where such violations are clearly contrary to specifications.

While in individual cases it may be desirable to make a slight alteration in a plan or specification, such changes should be undertaken with great care and should be authorized or approved by the proper authority. A careful preliminary study of plans and specifications will usually bring these questions up in ample time for securing a decision from the main office.

On road work it is required that a first-class road must have at least 15 centimeters (after rolling) of hard and durable surfacing material, built on a subgrade which conforms to the standard cross section adopted as suitable for the kind of country through which the road is constructed. The surfacing must be built in courses of certain specified thickness and of stone of a prescribed size and rolled according to definite instructions. Cases have been known when roads have been declared as first class when there was less than 8 centimeters of surfacing and the metalling material could not be classed as hard or durable. There is also one instance of a kilometer of road which was formally designated as first class where no surfacing material had ever been delivered on the subgrade. This designation was the result of a mistake and was made in good faith. It may be needless to say that this section was made strictly first class soon after the road was so designated. In the case of a few of the first-class roads by brevet we are still working on them and they will ultimately be fully entitled to their official designation.

The swelling of kilometerage of first-class roads at the expense of quality and without due regard to specifications is hardly fair practice as a prize of ₱15,000 is awarded to the province that constructs the most first-class road during the year.

The Philippine Islands have probably the best and most complete maintenance system in the world, and those roads which are up to the full Bureau construction and maintenance standards are justly entitled to the many compliments paid them by technical and non-technical men who have gone over them. This system has been improved from time to time and there is still chance for betterment. About the only possible excuse for not having a high maintenance

standard in all provinces is a shortage of funds or lack of trained men to follow out the ample instructions of the central office. On maintenance work a great deal depends upon the personal equation of the directing spirit, and the discipline he can enforce in his working organization, from foreman to caminero. A maintenance force which is undisciplined and careless cannot be depended upon to carry out directions. A section of road constructed and finished in accordance with specifications and instructions is much easier and cheaper to maintain than a section which has not been built fully up to the Bureau standard. In the first case the caminero has a model to follow and he cannot neglect any of the details of his work without its becoming plainly evident. He will take a pride in his work and be interested in keeping it in proper condition. On the other hand, a poor section will very likely get worse. The caminero will not be able to tell just what features require immediate attention and he will not have the same incentive to work. It will be difficult for his foreman to tell whether he puts in his full time or not and the caminero will very likely shirk his duties. A good section of road cannot be kept in first-class condition unless all concerned in its upkeep are doing their full duty and looking after the numerous details so necessary for successful and economical maintenance.

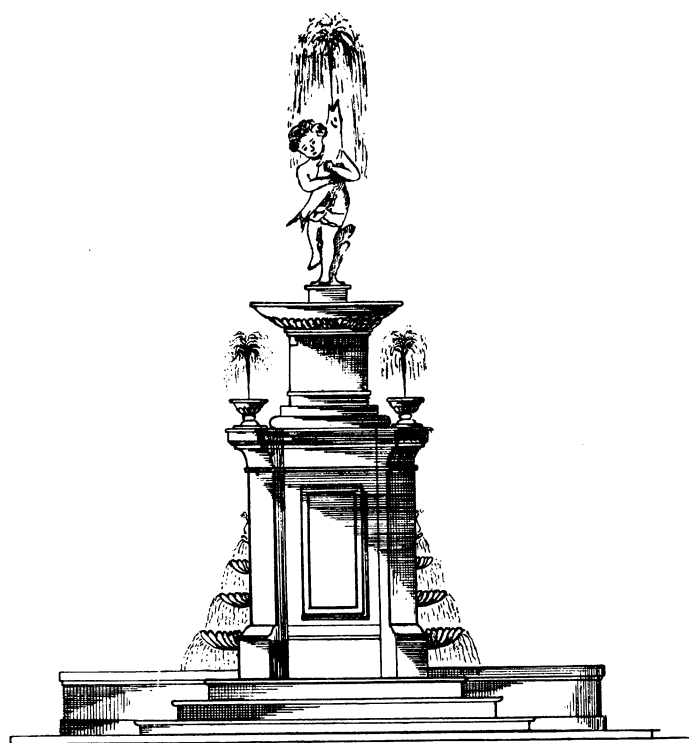
THE BOAC AND SARIAYA WATERWORKS SYSTEMS.

By HAMILTON V. MILES, C. E., Associate Member American Society of Civil Engineers.

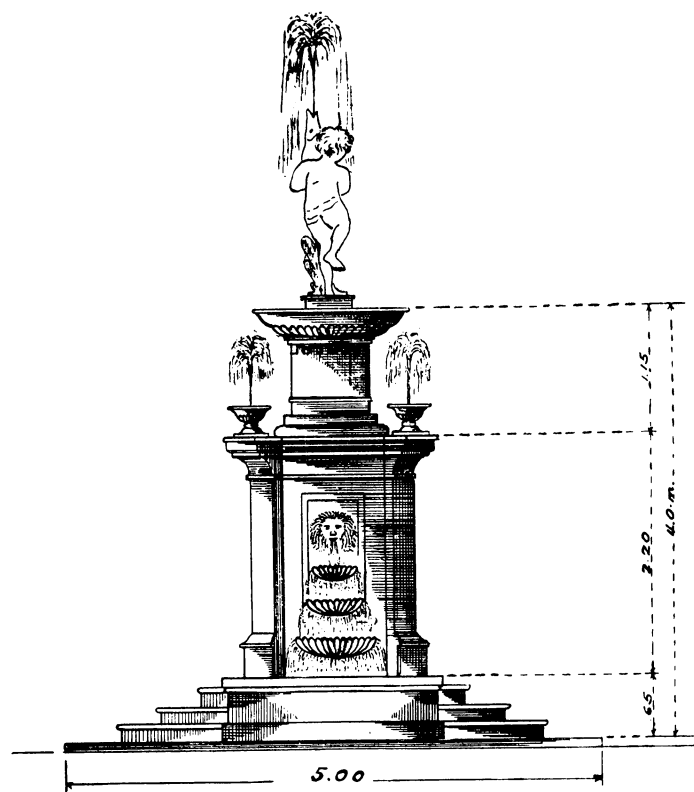
The purpose of this paper is to give details of construction, costs, etc., of two small water-supply systems lately installed by administration in Boac, Marinduque, and Sariaya, Tayabas. Both are typical provincial towns. A pumping system was adopted for Boac, a gravity system for Sariaya.



The G. Nieva Public Fountain, Boac waterworks, Tayabas Province.



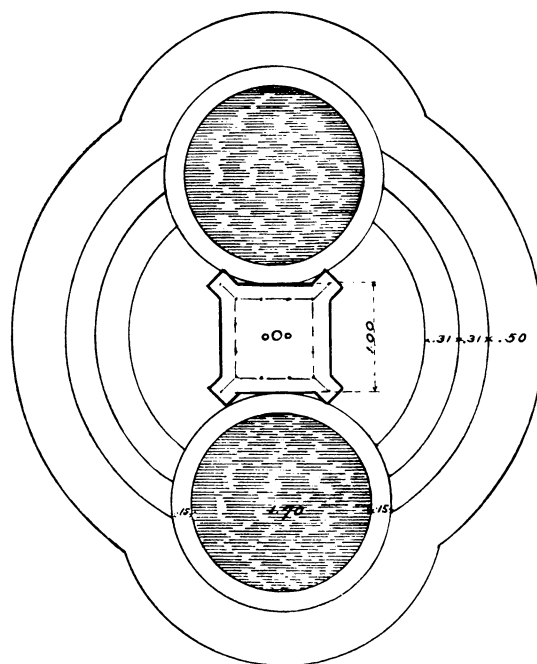
FRONT VIEW



SIDE VIEW



FOUNTAINS STATUARY ETC.
Hight 3 ft. 6 in.



PLAN

BOAC SYSTEM.

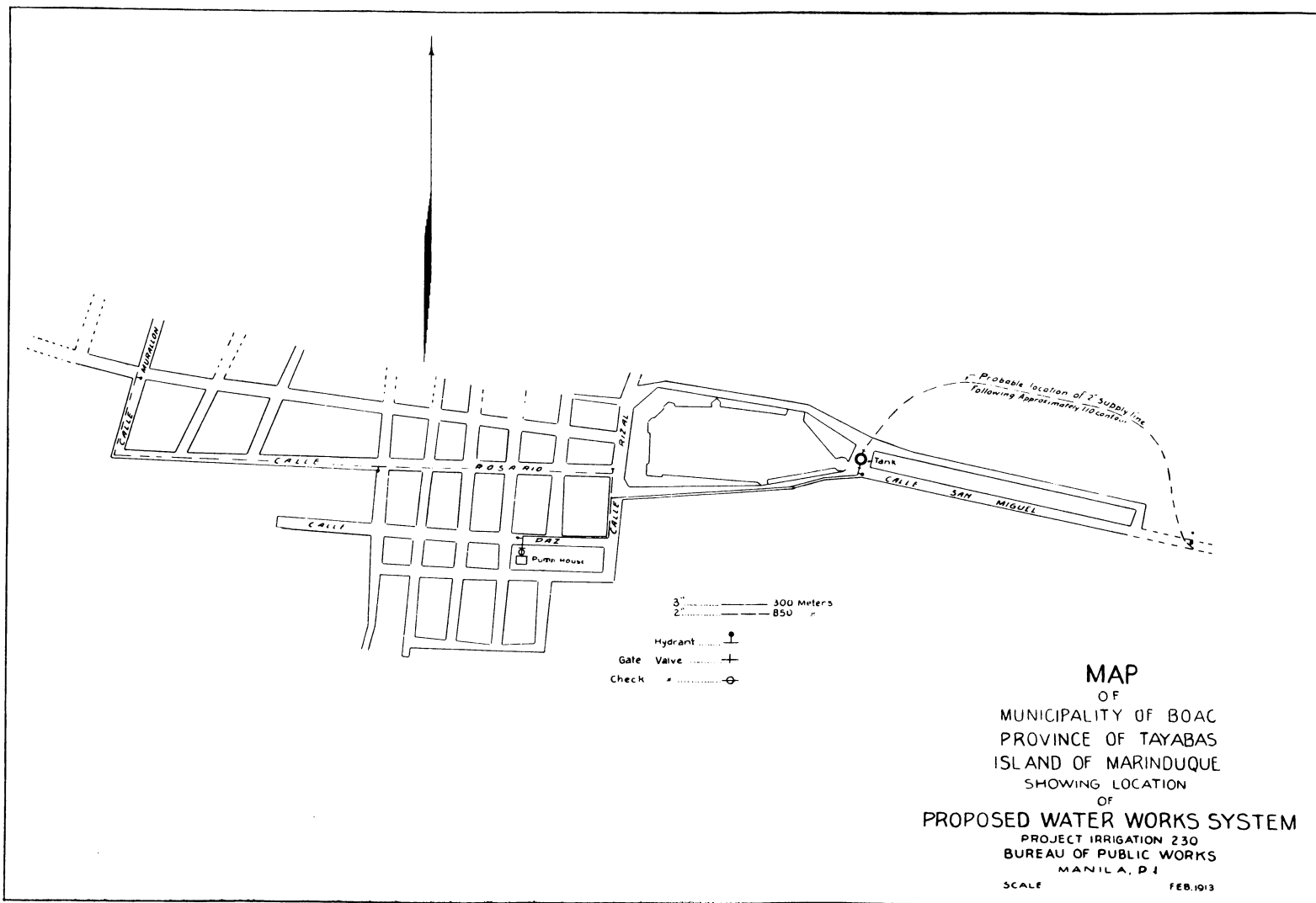
Boac, the capital of the subprovince of Marinduque, has a population, including its barrios, of 15,823, and had an assessed valuation in 1913 of ₱963,280. The population of the poblacion, or town proper, is 4,000. Like a great many other towns on small islands, water is scarce, and it has been impossible to secure a well with sufficient flow to obviate the necessity of pumping.

The founder of the present system is the Honorable Gregorio Nieva, then member of the Second Assembly for the Province of Tayabas, now private secretary to Speaker Osmeña. He obtained an Insular allotment of ₱5,000 by Act 2059, the subprovince furnished ₱2,500 more from its general fund, making available a total of ₱7,500. The work was authorized February 17, 1913. No bids were received,

piston speed of pump, is capable of delivering 40 gallons of water per minute against an effective head of 85 feet.

The pumping plant is located at the opposite end of the plaza about 100 meters from the wells. A 3-inch pipe line leads from the pump to the tank, which is placed on a hill 85 feet higher in elevation than the pumping plant, and distant 300 meters. A 2-inch distributing line leads from the 3-inch line to the main part of the town. There are 5 hydrants, located at every other street intersection in the main or lower town. Another 2-inch line leads from the tank to the main road, on a level even with the bottom of the tank, a distance of 500 meters from the reservoir. This line supplies the high part of the town. There are 2 hydrants on this line—one placed at the midway point and the other at the terminus of the line.

The tank is of reinforced concrete and is capable of holding 20,000



hence the work was undertaken by administration. The system consists essentially of two wells on the plaza, a pumping plant, a storage tank, and the distributing pipes and hydrants.

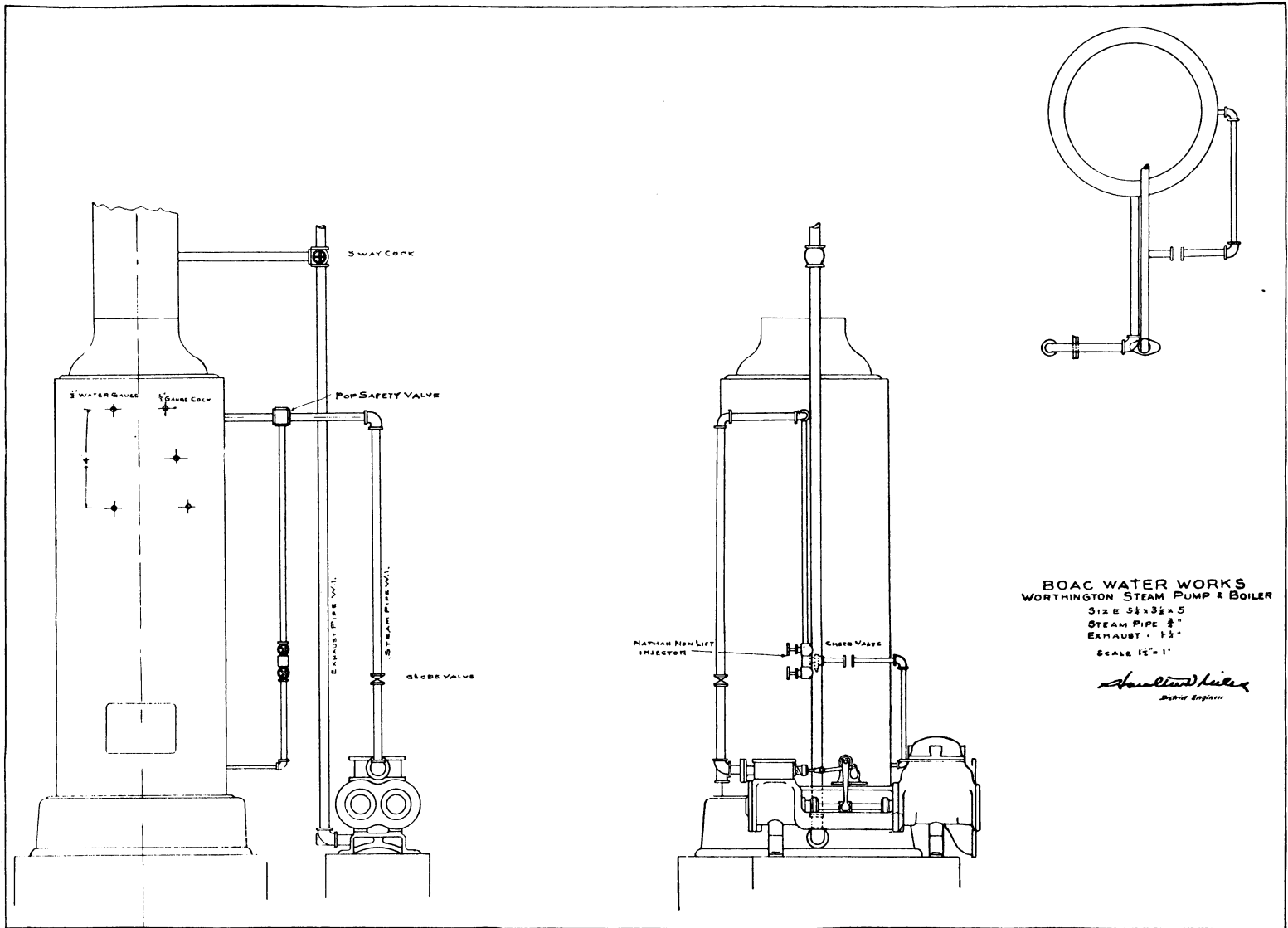
The wells are located at one end of the plaza, about 60 meters apart. They were driven with jet rigs, 3-inch drive pipe being used. Within each well is placed 25 feet of 2-inch suction pipe. The two pipes lead to a common tee from which a 3-inch pipe leads to the suction end of the pump. Concrete covers were securely placed over the well, so that no access by unauthorized parties may be had to the supply.

The pumping plant consists of one Worthington duplex steam pump and vertical boiler, size of pump 5½ by 3½ by 5 inches, with ¾-inch steam pipe and 1½-inch exhaust pipe. This unit, with normal

gallons. Details and dimensions are shown by figure 1. The concrete, 1:2:3½, was waterproofed by mixing 10 per cent of lime with the cement. This appears to have been successful, as no leakage has developed so far.

Besides the public hydrants, about 30 houses have been connected up with the system, with a possibility of more desiring this advantage.

Upon the completion of the system a balance of ₱1,496.30 remained on hand out of the original ₱7,500, so it was determined to place a fountain in the lower plaza. The pedestal was constructed of concrete by administration, while the life-sized statue of a Filipino child holding a fish, was cast in concrete by B. Nepomuceno, a Filipino sculptor located on Calle San Sebastian, Manila. It presents a very pleasing appearance.



The following financial statement may be of interest:

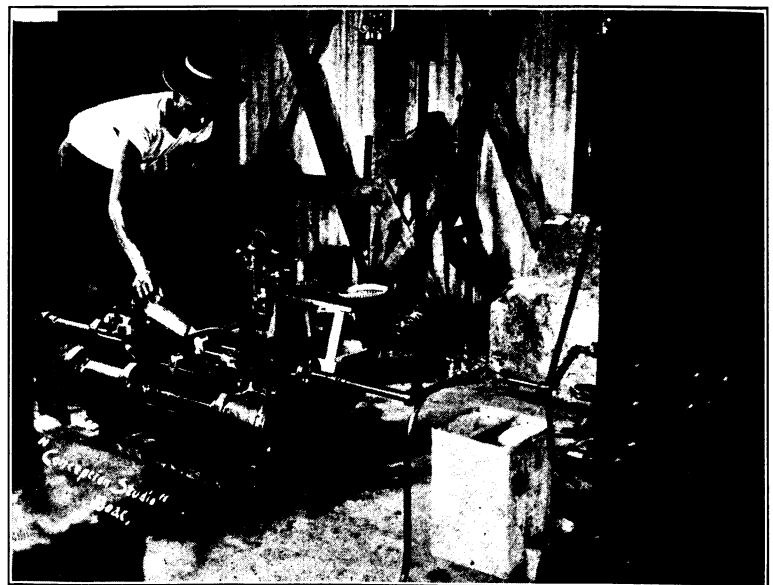
Appropriations:	
Insular allotment Act 2059	P5,000.00
Subprovince (general fund)	2,500.00
Insular aid	69.59
Total appropriation	P7,569.59
Expenditures:	
Miscellaneous	301.18
Labor	1,691.07
Bureau of Supply materials and local	2,776.58
Pumping unit (1 Worthington duplex complete)	735.09
Surcharges (Insular and provincial)	649.78
Insular aid	69.59
Liabilities:	
Bureau of Supply (concrete statue)	330.00
Surcharges (Insular and provincial)	30.29
Total	6,583.58
Balance	986.01

The system is small, but is very suitable for a town of 3,000 or 4,000 inhabitants, where water cannot be obtained from springs nor sufficient flow from wells without resorting to pumping. It is being maintained by the town of Boac, although there is talk of making it a provincial project, and as such, having the subprovince maintain it instead of the municipality.

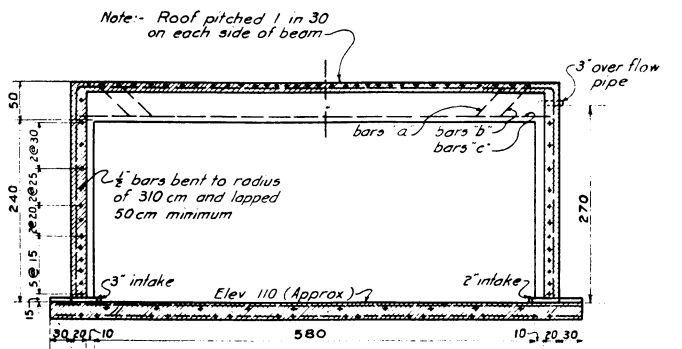
SARIAYA SYSTEM.

On July 31, 1911, the municipal council of Sariaya opened bids, based upon their own plans, for the construction of a water-supply system for the town. A local Filipino contractor bid the sum of ₱16,700, and was awarded the contract. The amount of his bid was

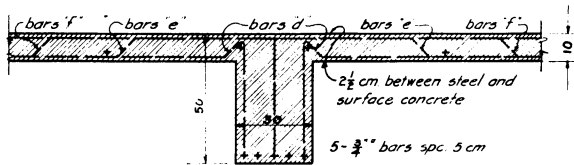
dictated by a Manila supply house, who stated, in a letter to him dated July 26, 1911, and signed by its vicepresident, that "from the sum of ₱16,700 we believe you may get a profit but never a fortune."



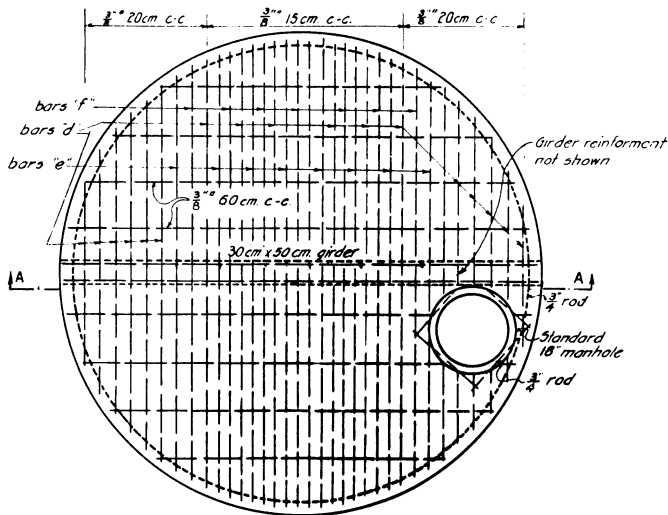
Pumping plant, Boac water system, Marinduque, Tayabas.



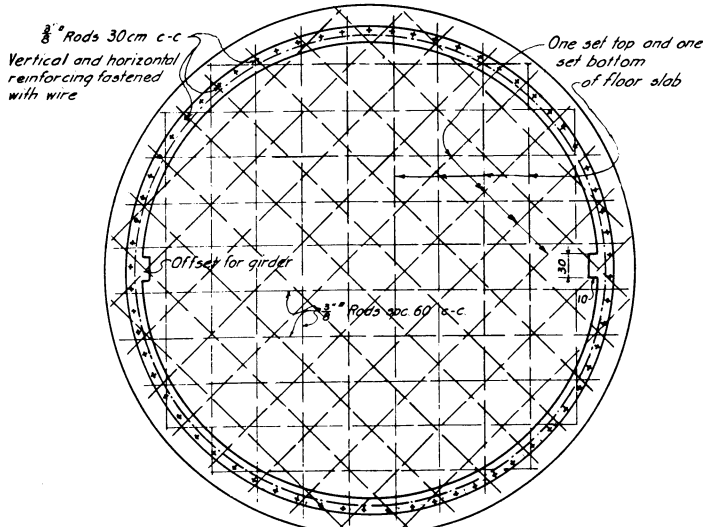
SECTION OF TANK ON A A
SCALE - 1:50



SECTION B B
SCALE - 1:10



PLAN OF ROOF REINFORCING
SCALE 1:50
Dimensions in cms unless other wise noted



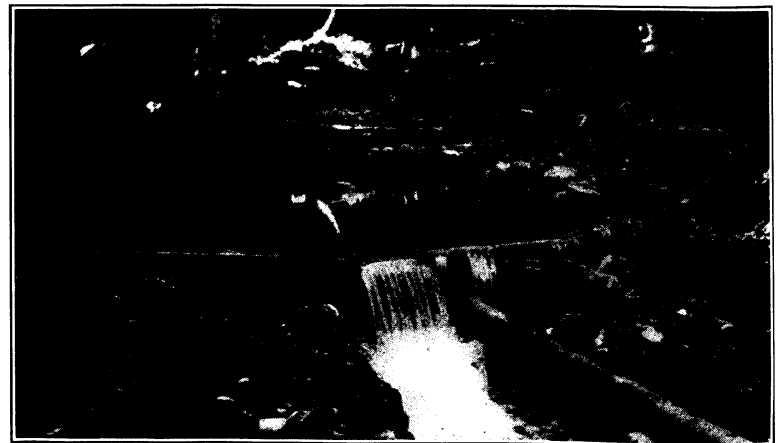
SECTIONAL PLAN
SCALE 1:50
Dimensions in Centimeters

It is sad to relate that the local contractor obtained neither the profit nor the fortune. It developed later that this supply house had used a pipe fitter to furnish the figures submitted. On September 18, 1911, the contractor requested the council to augment his contract by ₱8,000



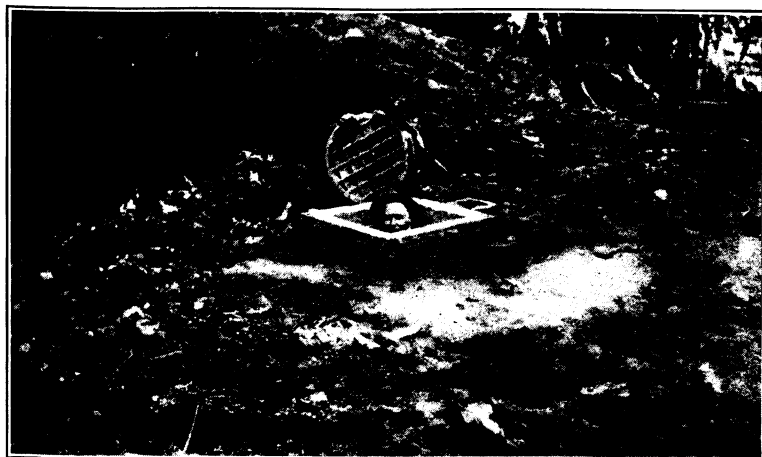
Street hydrant, Boac water system, Marinduque, Tayabas.

additional. This was refused. On June 24, 1912, he requested the council through the provincial board to augment the contract by ₱11,585 additional, instead of ₱8,000. The matter was now, for the first time, referred to the district engineer, who estimated the job at ₱38,500. Nothing extra was allowed the contractor, who had ceased all work.



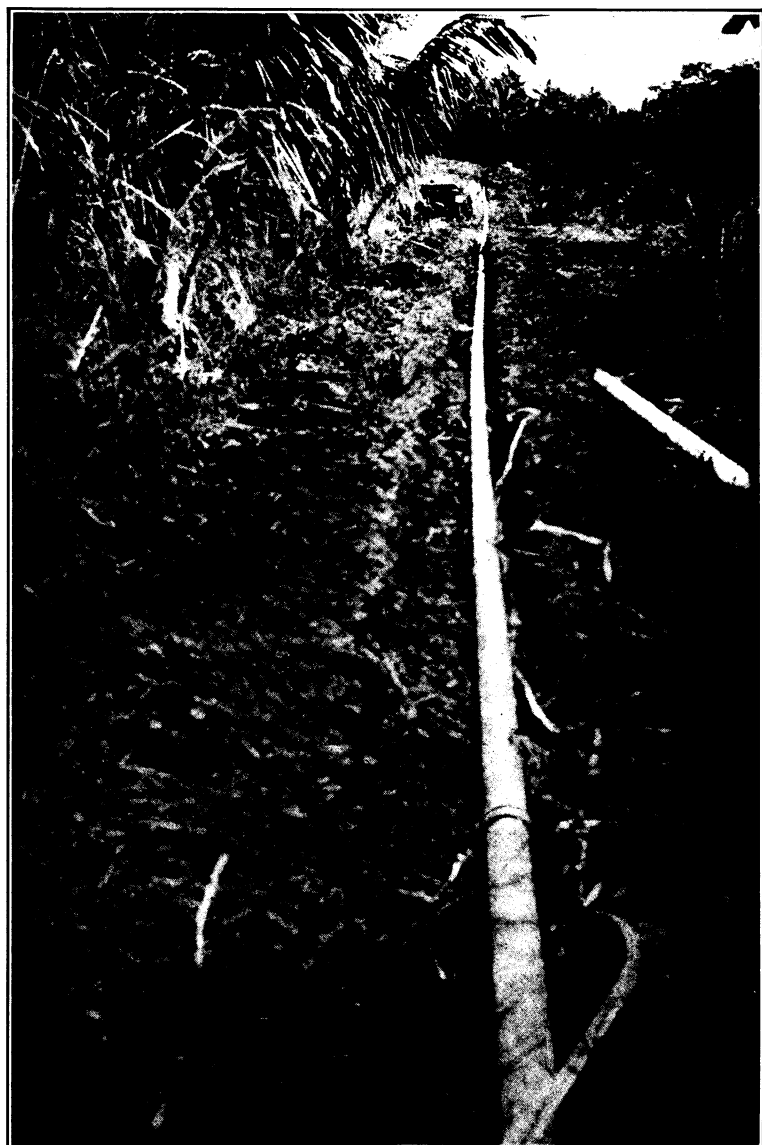
Sariaya waterworks, Tayabas Province, intake and waste.

On May 15, 1913, the municipal council, by resolution No. 78, requested the Director of Public Works to take control, straighten out the affairs of the project, and complete the work. It was discovered that the contractor owed ₱7,014.99 to the supply house for materials,



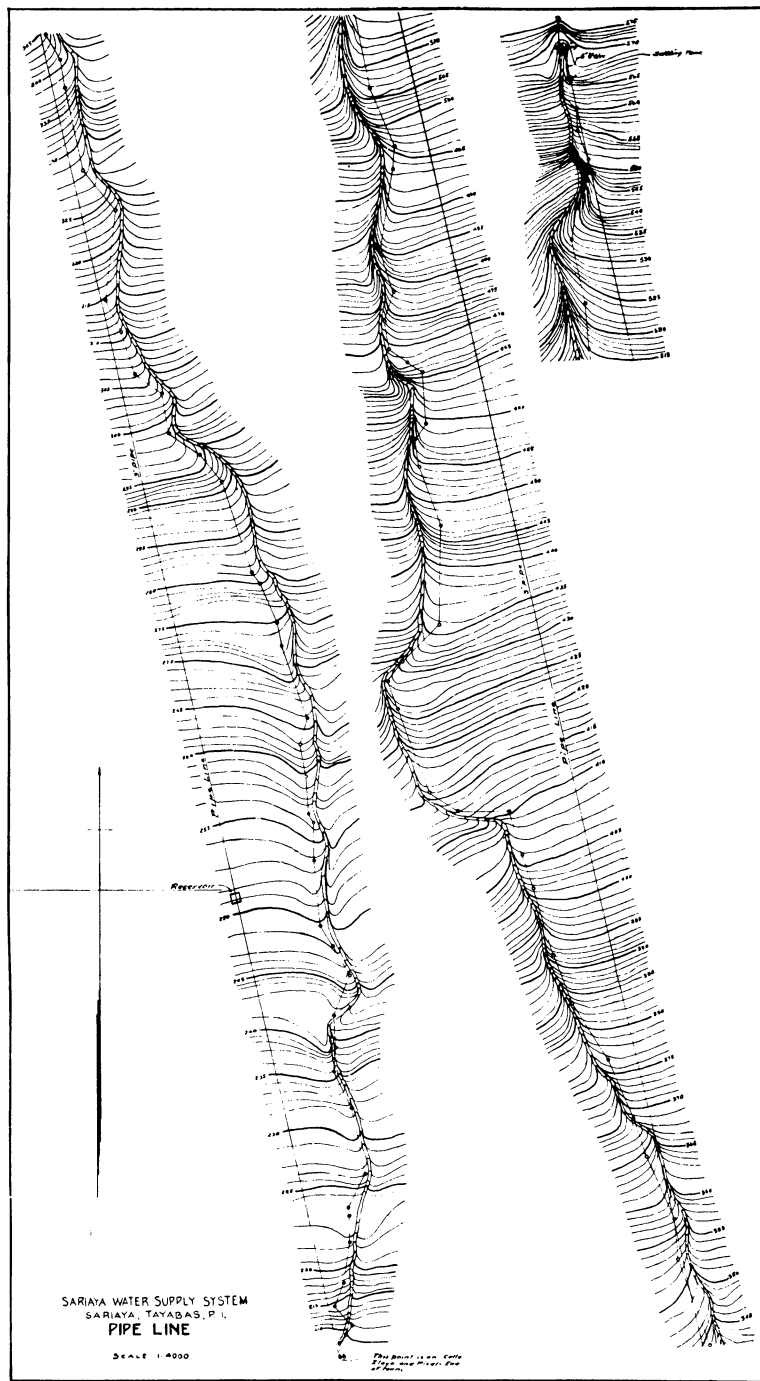
Sariaya waterworks, Tayabas Province. Manhole leading to concrete settling tank.

that he had been paid ₱4,000 on work already accomplished, and that this work, estimated to have cost him ₱1,990, was utterly useless. It was finally decided to take over the materials at ₱7,014.99, paying the supply house for them, and to allow the contractor the estimated cost of work already done, requiring him to refund the amount overpaid him. This he agreed to, returning ₱2,010 to the municipality.



Sariaya waterworks, Tayabas Province. Three-inch pipe running from settling tank to the reservoir; distance, 5 kilometers.

The Filipino contractor cannot be blamed, since he acted in good faith. The blame lies first of all with the municipal council, for attempting such a proposition without intelligent engineering advice, and finally with the Manila supply house, who offered, over the signature of its vicepresident, such a sure way to fame if not to fortune.



The town of Sariaya, including its barrios, has a population of 9,062; assessed valuation, ₱1,729,320. The population within the población is 4,160. The town lies on the lower slopes of Mount Banahao, distant 8 kilometers from the mountain.

The source of supply for the water system is a large spring in the rocks on the side of the mountain, distant 6 kilometers from the town. During the wet season of last year the flow of the spring was 47.6 gallons per second (6.36 second-feet), while during the present dry season its flow has been 20.48 gallons per second (2.75 second feet). At its minimum flow, this gives 237,600 cubic feet, or 1,777,316 gallons, per day of twenty-four hours.

The spring is supplied with a concrete intake for impounding the water. This has a rectangular waste weir for the surplus flow.

surface. The line discharges into a concrete reservoir with a capacity of 150,000 gallons. Open standpipes are placed every 1,000 meters in the line to relieve the pressure. Each is of 3-inch pipe, cut 3 meters high, so as to insure its top reaching above the hydraulic gradient at that point. Each is capped and has 40 half-inch holes drilled into it near the top.

The present waste of 1,398,634 gallons will be utilized later. It has been decided to place a larger pipe and to install a water wheel, thus furnishing a hydroelectric proposition, so that the town may control its own electric lighting plant.

The reservoir is located at the end of the 3-inch supply pipe, 900 meters distant from the town and 5 kilometers from the spring. It is of reinforced concrete, 16.90 meters square and 2.3 meters deep, the sides having a slope of 45°. Its capacity is 150,000 gallons. The bottom and sides are waterproofed with asphaltic paint. The overflow pipe is 6-inch, and is fitted with a 6-inch gate valve. The discharge to the town is by means of a 6-inch pipe controlled by a 6-inch gate valve fitted with Yale & Towne brass lock. Access to the valve is through a 60-centimeter concrete manhole. There is a 3-inch pipe, connecting the mains above and below the reservoir, for use while the reservoir is being cleaned. This pipe is fitted with a 3-inch open standpipe like the ones on the 3-inch main.

The excavation for the reservoir was in rock, not solid, but with pieces ranging from the size of one's head to 4 cubic meters. The rock was very hard and required the incessant use of dynamite.

The reservoir is 41 meters above the level of the highest part of town. The water main, 900 meters in length, is 6-inch galvanized iron laid on a grade of 4.55 per cent. All the streets in the town are piped, the sizes of pipe varying from 6 inches for the main to 4, 3, and 2 inches. There is a hydrant at every street corner and 100 houses have applied for house installation. A fountain is to be placed in the plaza similar to the one installed in Boac. All the fittings throughout the town are extra heavy to withstand the fire pressure. Fire streams of 120 gallons are obtained.

At the present writing the work is awaiting the receipt of the extra-heavy fittings from the States, as the same are not available in the Islands.

Certain data as to flow of water at various points in the system are here tabulated for easy reference:

Place.	Quantity.	Quantity per 24 hours.	Velocity per second.	Dimensions.
Spring	Sec. feet. 2.750	Gallons. 1,777,376	Feet. 0.222	2 meters by 60 centimeters.
Intake	2.150	1,389,586	10.960	6-inch pipe.
Waste weir	.600	387,790	3.60	Rectangular, 5 by 30 centimeters.
Settling tank	2.150	1,389,586	10.96	8 by 9.6 by 3 feet.
Overflow from tank	1.564	1,010,844	7.96	6-inch pipe.
Upper end 3-inch pipe	.586	378,742	11.97	3-inch pipe.
Lower end 3-inch pipe	.586	378,742	11.97	Do.

Financial statement and unit costs.

Appropriations:		
Special fund		P17,167.30
Insular loan, Acts 1749 and 1323		16,400.00
Municipal, Resolution 88 (1914)		2,000.00
Insular aid		2,169.68
Total appropriation		P37,736.98
Expenditures:		
Miscellaneous		1,262.00
Labor		3,756.51
Bureau of Supply materials and local		18,252.12
Materials (native contractor's)		7,014.99
Surcharges (Insular and provincial)		3,150.93
Insular aid		2,169.68
Liabilities:		
Bureau of Supply materials		335.00
Surcharges (Insular and provincial)		296.46
Total		36,237.69
Balance		1,499.29

Specification.	Unit.	Quantity.	Cost.	Unit cost.
Clearing	Square meter	1,600	P177.20	P0.11
Trenching for pipe line, rocky at several points	Cubic meter	252	437.66	1.75
Furnishing and delivering pipe:				
6-inch	Linear meter	42	214.54	5.10
3-inch	do	4,358	8,729.75	2.01

Specification.	Unit.	Quantity.	Cost.	Unit cost.
Laying pipe, labor only:				
6-inch	Linear meter	42	P12.18	P0.29
3-inch	do	4,358	643.31	.15
Intake:				
Excavation	Cubic meter	9	16.40	1.82
Concrete, 1 : 2 : 4	do	3	92.65	30.88
(Materials cost P32.25. Sand, gravel, and cement were hauled 8 kilometers up the mountain. Average grade, 7.3 per cent.)				
Settling tank:				
Excavation	do	27	61.80	1.92
Concrete, 1 : 2 : 4	do	10	391.76	39.18
(Materials cost P322.04, hauled as above.)				
Reservoir:				
Excavation, chiefly rock	do	938	2,121.14	2.26
Concrete, 1 : 2 : 4	do	61	1,256.53	20.59

REINFORCED-CONCRETE PILE SUBSTRUCTURE FOR CONCRETE BRIDGES.

PRESENT METHODS OF CONSTRUCTION AND ADVISABLE IMPROVEMENTS.

By J. L. HARRISON, District Engineer, Bulacan Province.

Reinforced-concrete piles are not a new thing nor is their use in bridge construction uncommon. Their use in the construction of the substructures for reinforced-concrete highway bridges has, however, been more systematically developed in the Philippine Islands than it has been in any part of the United States. As the results so far secured have been uniformly indicative of the intrinsic merit of this form of substructure, a discussion of the methods of construction now in vogue in the Philippine Islands may serve to make clear the reason for some difficulties which have been encountered, and incidentally to make possible a wider use of that type of bridges which is adapted to use with this form of substructure.

THE PILES.

The piles used in the Philippine Islands are cast in the form of a shaft 40 centimeters square in section through the major portion of their length, but tapering from a point 3.5 meters from the point of the pile to a section 25 centimeters square 12.5 centimeters from the point. A 20-centimeter piece of 3½-inch angle is used as a shoe for the pile. All corners are chamfered. Four corrugated steel bars, 2.5 centimeters square, together with numerous hoops of 0.6-centimeter steel, are used to reinforce each pile. No hole is cast along the axis of the pile as it is usually thought that the water needed for cutting away the earth ahead of the pile can be satisfactorily supplied by jets forced down alongside of it.

It will be noted (see fig. 1) that the heavy reinforcing bars are made to extend beyond the concrete 1.2 meters. This is done in order to provide a substantial bond between the driven pile and the cap which must rest on it and to facilitate splicing should this be necessary. Theoretically, this is an advantage as it insures a more substantial connection between the pile and the cap; but from a construction standpoint there are objections to this practice, as the cushion used in driving the pile must include a driving block or follower which, when projecting reinforcing is used, has to fit inside of the projecting rods. If the reinforcing rods are 5 centimeters from the surface of the concrete, the follower will usually have less than half of the sectional area that the pile has. Two unfavorable conditions result. First, the cushion is compacted under the follower more than it is outside of the reinforcing bars. As a result, these heavy bars are bent out. Second, the blow of the hammer, when delivered through a follower of small section, is much more intense over the center of the head of the pile than it is at the outer edges. It is true that the cushion ought to distribute the blow, but the fact is that it does not. As both the bending of the reinforcing bars and the excessive pounding on the center of the head tend to spall off the concrete around the top of the pile, the advisability of extending the reinforcing bars above the concrete would seem to be questionable.

Practical experience bears out this view of this matter. On the Pinagtulayan and Patay Bridges, Bulacan Province, hard driving was encountered, the piles often reaching a bearing of between 20 and 30 tons. Under the adverse conditions prevailing, the piles were crushing

badly, a meter or more being the usual loss. As this breaking down of the head of the pile required a frequent readjustment of the steel jacket which held the cushion in place, and a consequent loss of time, the foreman in charge of the driver requested permission to cut off the extending reinforcing bars which, according to his view, were the cause of the failure of the pile heads. As it seemed likely that there might be some justification for his opinion the requested permission was given and, for purposes of test, the extending bars were cut from two or three piles. When these piles were driven the difference surprised all who watched the experiment. There was still some crushing of the heads of the piles, but with the extending rods removed they were usually put down without resetting the jacket and quite frequently one was finished without more damage than a little spalling of the corners at the very top of the head.

A few piles on this job had been cast so that the concrete covered the full length of the vertical reinforcing rods, but the contractor, not appreciating the reason for the closer spacing of the hoops in the pile head, had "put the reinforcing in according to plan" thus leaving the top of these piles entirely barren of hoops. A comparison of the number and the height of the blows required to break down the concrete which contained no hoops, with the number and the height of the blows required to break down the regularly reinforced head, suggested the idea that the number of hoops used in the head of the pile could be advantageously increased. Accordingly, on the Guiguinto Bridge the contractor was advised to double the reinforcing in the head of the pile. He did not do exactly this, but instead took 9.1-meter bars of 0.6-centimeter round reinforcing steel and bent them into spirals having a pitch of about 5 centimeters. One of these bars he placed in the head of each pile. He also cast his piles to the full length of the reinforcing bars. The driving was comparatively easy, but the excellent results obtained justify the impression that eliminating the projecting rods and increasing the number of hoops in the head of each pile would be an advantage from the standpoint of the constructing engineer.

For the concrete piles 1 : 2 : 4 concrete is used. The results so far observed have not shown that a rich mixture is necessary, but at the same time the results of recent experiments on the effect of the electrolytic action on the steel imbedded in concrete, together with the results of tests on the effect of salt water on concrete structures, lead to the suggestion that a better grade of concrete might well be considered. This much is certain: (a) Electrolytic action may result from stray currents generated outside of a structure, from currents set up between the steel, and impurities in the concrete and from currents set up on the surface of the steel by impurities in the steel. (b) The saturation of concrete materially lessens its resistance to electric currents. (c) Chlorine salts are very effective as aids to electrolytic action. In fact (U. S. Bureau of Standards, Technical Paper No. 18) "the addition of 0.02 per cent of CaCl_2 to the cement results in a very marked increase in the efficiency of corrosion." And again, from the same source, "the addition of a small amount of salt to concrete * * * destroys the passivity of iron at ordinary temperatures, thus multiplying by many hundred times the rate of corrosion and consequent tendency of the concrete to crack. Furthermore, reinforced-concrete structures built in contact with sea water or salt marshes are more susceptible to electrolysis trouble than concrete not subject to such influences." Both water and chlorine salts add to the effectiveness of internally stimulated currents as well as to the effectiveness of externally stimulated currents. As electrolytic action is now pretty generally believed to be the basis of all serious rusting, the importance of having impervious concrete, especially where piles are to be driven in salt or brackish water, becomes apparent at once. (d) A pile is subject to much rough handling. It is cast on a heavy plank floor and turned over when a week or so old in order to make the floor available for casting other piles. It is picked up by a heavy engine and dragged and jolted to the driver. Finally, it is driven into place by means of a heavy hammer. All of these processes are hard on a brittle material like concrete. In fact, it is not too much to assert that it is probable that a very small proportion of the piles driven in most structures reach their final bearing free from cracks. It is true that experience has shown that ordinary structures are reasonably permanent regardless of whatever cracks result from normal settlement

or ordinary loading; but as reinforced-concrete structures are usually comparatively dry and as piles have a more or less extensive wetted section, often in salt water, it is quite likely that time will show that more care than is now thought necessary must be exercised in securing a perfect pile of dense and high-grade material and in using every precaution to prevent damaging it. The simplest and also the most effective way of securing a perfect pile properly placed is likely to be (1) the using of a somewhat richer mixture, (2) the placing of the reinforcing bars somewhat farther from the surface, (3) the refusal of permission to turn piles over until full strength is developed, and (4) the use of proper equipment for handling and driving. The first two proposals have as their purpose a greater protection of the reinforcing by placing it in a denser concrete and farther from the surface, while the latter provisions have as their purpose the prevention of damage to the pile once it has been properly cast. Neither phase of this matter should be overlooked, for it will be useless to build piles of better material unless proper precautions are taken to see that they reach their final bearing in perfect condition.

CASTING THE PILES.

When piles are to be cast, heavy floors are laid on the ground and the piles cast on these floors. The reinforcing is assembled in the steelyard, a completed reinforcing unit being placed in a completed form and carefully secured in its proper position before the pouring of concrete is begun. A wet mixture is used, and careful spading is required in order to insure that the concrete packs properly around the reinforcing bars.

After a pile has set seven days it is turned off of the casting floor so that the floor can be used for another pile. It has been observed that under ordinary field conditions a certain proportion of the piles are cracked in turning them over and that corners are often broken. As both cracks and plastered areas are likely to leak, and as water, and particularly brackish or salt water, is very effective as an aid in the destruction of the reinforcing, it would seem that it might be advisable to forbid the turning over of piles until they are thoroughly seasoned. To leave all piles where they are cast until they are needed in the structure for which they have been prepared might add somewhat to the amount of form lumber needed on a job, and it would increase the area needed for floors, but the cost of this more rigorous requirement would be entirely warranted if it insured that the piles could reach the driver free from cracks and patches. Of course, even with these precautions a careless man will probably do some poor work, but if the probable results of poor work are fully appreciated and the opportunity to do poor work reduced, a minimum will result.

When a pile has set for thirty days, specifications permit that it be driven. It may not be advisable to lengthen this period, but it has been observed that piles which have seasoned for from fifty to sixty days show less tendency to shatter than do greener piles. This difference in strength appears to be out of proportion to the rather insignificant difference that records of experiments on small laboratory specimens show to be normal as between concrete thirty days old and concrete sixty days old. It may be, however, that the development of full strength is slower in a mass of concrete as large as a pile than it is in a small laboratory specimen. The fact remains that, of the piles driven in Bulacan Province during the past two years, those which had seasoned sixty days or more were appreciably stronger than those only about thirty days old.

DRIVING THE PILES.

For driving concrete piles, equipment about as follows is in general use in the Philippine Islands.

Pile-driving derrick, 35 to 40 foot leads.

Steam hoisting engine with winches and drums for lifting piles and operating the hammer, 16 to 25 horsepower.

Hammer, 2,000 to 3,000 pounds.

Pumps, usually duplex feed water pumps, 3-inch intake and 2-inch discharge. One and sometimes two such pumps are found on an outfit as ordinarily equipped in this country.

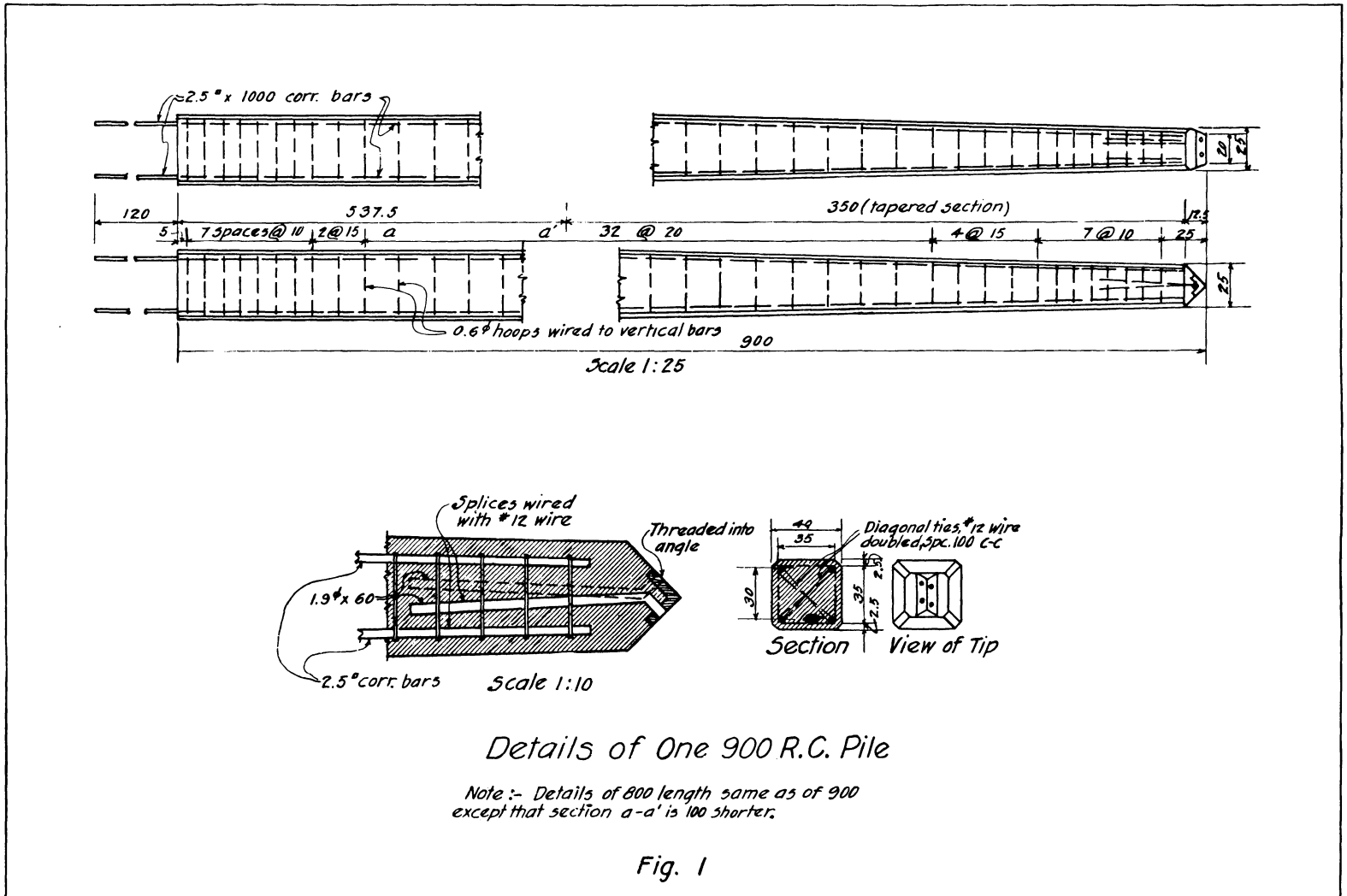
Steel jacket to hold the cushion on the top of the pile head.

Tackle of various sizes and grades. Outfits usually have an inadequate and poorly selected supply of tackle.

The driver is usually operated on a false work of wooden piles. The concrete piles are picked up and swung into the leads in about the same manner that wooden piles would be handled. Once in the leads, they are plumbed, braced into proper position, and allowed to settle slowly into the ground as far as their weight will carry them. They are then checked for position and if errors are found they are, so far as possible, corrected. The steel jacket, and cushion are then placed over the head of the pile, the pumps started, and as soon as the cushion is properly adjusted driving is begun. Both jetting and driving are continued until the pile is driven to proper position. An effort is made to keep the jets ahead of the pile, but because they are not very powerful this is often impossible. When the jets fail to make a proper hole for the point of the pile to enter, practically all of the work involved in placing the pile falls on the hammer. If the

impression that better results would be secured if contractors were required to use a steel jacket and cushion of standard design. Unless the jacket is long enough and strong enough and unless the cushion is made of proper materials, the pile heads suffer badly.

The points that have been brought out so far are points about which there is some room for argument. There is, however, no room for argument as to the capacity of the pumps and the size of the hammers now in use on pile-driving jobs in the Philippine Islands. Both the pumps and the hammers are entirely inadequate for the work they have to do. Concrete piles, as has been pointed out before in this article, are so placed that they are much more likely to suffer from the rusting of their reinforcing, and if in very salty water even from the deterioration of the concrete, than is the superstructure that they support. There is, therefore, no justification whatever for the



hammer is light, this means long drops and either damaged piles or insufficient penetration.

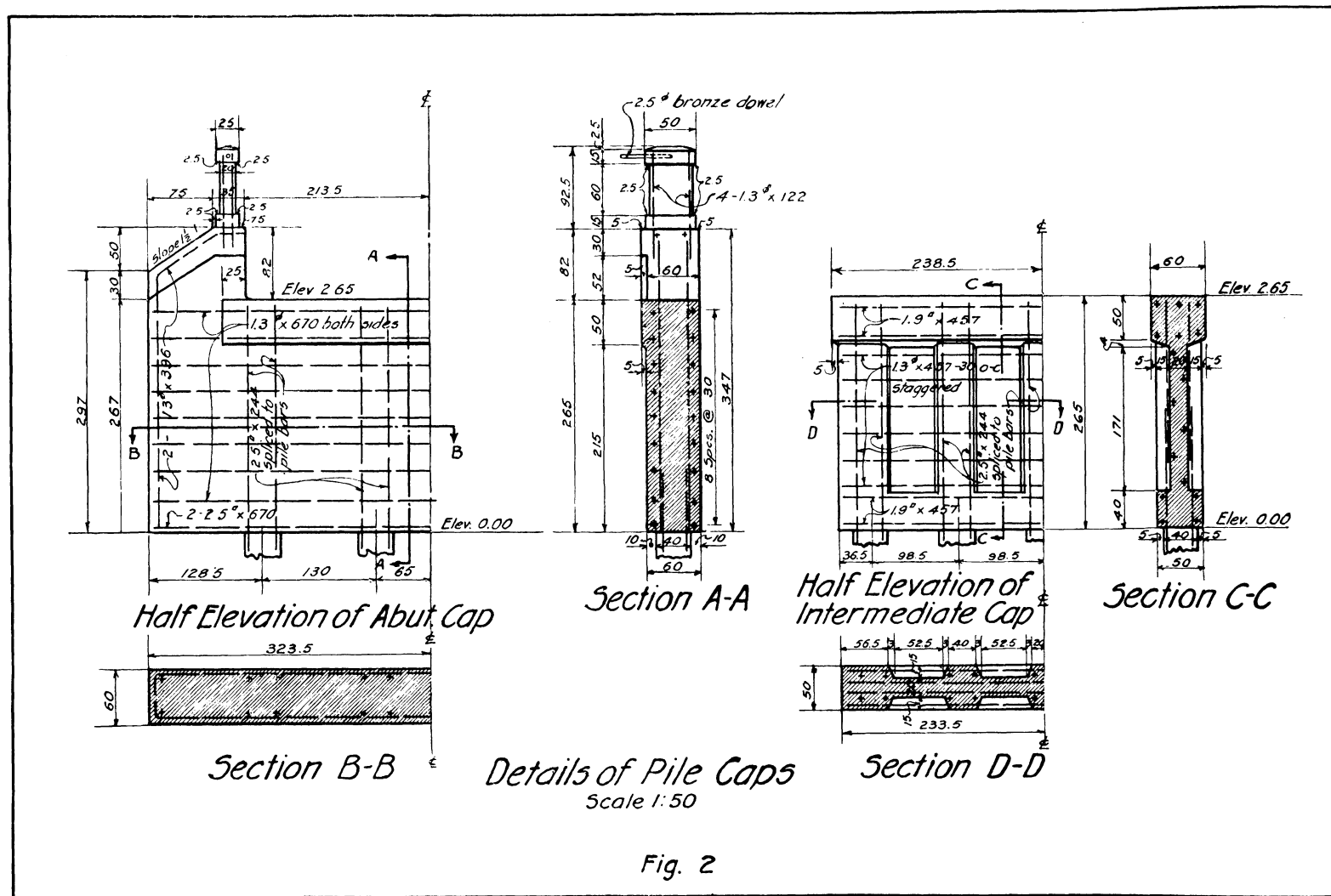
There is no standard steel jacket designed for use in the Philippine Islands, nor is there any standard form of cushion. Some contractors have used a steel jacket only about 2 feet long and built up of half-inch plates. The inadequacy of this sort of a jacket was so evident that it has been abandoned and now a steel jacket 40 centimeters square (inside section) and from 90 to 120 centimeters long, built up of 2.5-centimeter plates and heavy angles, is usually used. This is placed over the head of the pile in such a manner that from 30 to 50 centimeters of the head of the pile is covered by the jacket. The jacket is then bolted up tight and a foot or so of the remainder of its length filled with sand, sawdust, rope, or wood chips, or combinations of these materials, which act as a cushion between the pile and the hammer. A careful observation of a good many crushed pile heads leads to the

use of any apparatus that can put down a pile only by a driving process that shatters a large portion of the shaft, for it is quite probable that any driving that is so severe that it shatters the head of a pile will produce more or less cracking throughout the entire length of the pile, thus allowing water to enter the pile and attack more directly both the concrete and the steel. In fact, on a job in Bulacan Province, where the contractor attempted to force some of his piles, it was found that the excessively heavy driving had opened horizontal cracks something like 50 centimeters apart along the whole exposed length of the overdriven piles. Perpendicular cracking along the reinforcing rods was also noticeable. This cracking was easily visible to the unaided eye. How much more cracking there was that could have been detected in a testing laboratory it is not possible to say, but it would seem reasonable to suppose that there must have been a good deal more cracking that it was impossible for the unaided eye to detect on the

rough surface of these piles than there was that could be seen. As cracks of all sorts permit water to enter the concrete and as excessive driving evidently causes more or less cracking, the reason for urging the use of more adequate machinery can readily be seen.

The pumps used on a concrete pile driving job ought to be real pumps, not little squirt-gun affairs. The size of the stream needed and the pressure which will give the best results will, of course, depend on the material into which piles must penetrate. Fine sand or silt can be moved more easily than can gravel or clay. But this much should be clear, the jets should do most of the work of making the hole into which the pile is to go. If this is to be done there must be real power in the jets. On one job of which the writer had some knowledge the pumps delivered rather less than 50 gallons of water per minute at a pressure of about 30 pounds per square inch. In other words, the jets operated on this job had the ridiculously low

energy developed by the smaller hammer is transferred to the pile is twice as high as it would be for the heavier hammer delivering the same blow. But if the rate at which this energy is transferred to the pile is greater than the rate at which it can be carried from particle to particle in the pile the resiliency of the head of the pile is overcome and rupture results. Stated a little differently, if the elasticity of a pile were perfect the energy transferred from the hammer would be distributed to all parts of the pile without an elapse of time. As its elasticity is by no means perfect, the rapid application of energy and motion at the head of the pile causes the head to be overcompressed before the inertia of the lower part of the pile is overcome. Whatever force applied in compressing the head is in excess of the ultimate resilient strength of the head causes rupture. There is no formula by which the amount of suddenly applied energy that will produce rupture can be computed (Mechanics of Material, Merri-



capacity of less than 1 horsepower at the nozzles. This might have been done well enough for sprinkling lawns, but it was hopelessly inadequate as a means of moving earth. It takes power to move earth with a water jet just as it takes power to move it with a drag-line scraper or a dipper dredge. In fact, at least ten times as much power as it is now customary to use will have to be available at the nozzles of the jets provided for pile-driving outfits before their owners can successfully claim to be able to do effective work.

About this same inadequacy prevails in regard to the hammers used in the Philippine Islands. In order to properly drive a concrete pile a blow of from 40 to 50 foot-tons is necessary. Of course, a 2,000-pound hammer can deliver such a blow if dropped far enough, but for that matter so can a tack hammer. The point is that where a light hammer and a long fall is used the blow is delivered too quickly. For instance, a railroad spike drives quite readily under the blow of a

railroad hammer, but considerable difficulty would be experienced in driving it with a tack hammer. It might be possible to hit a blow with a tack hammer that would have in it as much energy as is ordinarily developed when a railroad hammer is used. Still, everyone would readily admit that the tool to use in driving a railroad spike is a railroad hammer. The principle that anyone instinctively feels as applying to the driving of a railroad spike applies equally to the driving of a heavy pile. The energy of the blow is one factor, but the time within which it is applied is a factor about equally important. In order to develop the amount of energy required to strike an effective blow, a small hammer falls so far that its velocity is high. In fact, a comparison of the velocities at which a 1,000-kilo hammer and a 5,000-kilo hammer will be, respectively, falling if a blow of 40-foot-tons is delivered will show that the lighter hammer is falling twice as fast as the heavy hammer. This means that the rate at which the

men, page 346). Experience is the only guide. As experience shows that a drop of from 6 to 8 feet is all that concrete piles will stand without crushing, the necessity for the use of heavy hammers is evident.

As it is of first importance that piles should reach their final bearing without being shattered and as this can only be accomplished by casting piles of the highest quality and then using adequate power in placing them, it is suggested that no outfit which does not possess pumps that can develop at least 10 horsepower at the nozzles of the jets used and a hammer that can develop at least 40 foot-tons in a fall of not to exceed 8 feet, together with boilers and engines large enough to operate such equipment efficiently, ought to be accepted as satisfactory for placing concrete piles.

THE CAP.

When the piles for a complete bent have been driven, a form is built at the proper elevation, the cap reinforcing placed, and the cap (see fig. 2) poured. The cap is usually 50 centimeters thick and is held in place by the rods projecting from the tops of the piles. Freedom from dangerous lateral motion is insured by setting the bottoms of the girders, which are later cast on these caps, 5 centimeters below the top of the caps.

Where these caps are cast in salt water it is felt that more care should be exercised in order to prevent the steel from coming into contact with the salt water. The steel in the caps is likely to rust more rapidly if it has been allowed to come in contact with strong brine. Even careful cleaning will fail to entirely eliminate the bad effect of such immersion.

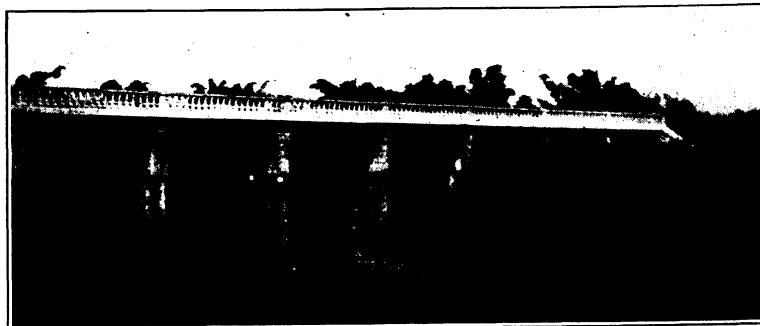
SUMMARIZING.

The concrete-pile substructure has a number of points that recommend it strongly to an engineer. In the first place, it is cheap. There is no permanent substructure now used in the Philippine Islands which is anything like as cheap except the steel cylinder filled with concrete, and it must be admitted that, because of the high cost of steel, even this form of construction has usually cost more than concrete piles.

In the second place, a pile substructure is comparatively easy to erect. As with every other form of construction, experience is of great value. Still, the fact remains that the risk of loss because of floods or other adverse conditions is far less than when substructures are built that require the use of cofferdams.

In the third place, the cheapness of this form of substructure enables the designer to so reduce his length of span that a very economical length of slab and girder unit can be used. In the Tropics steel

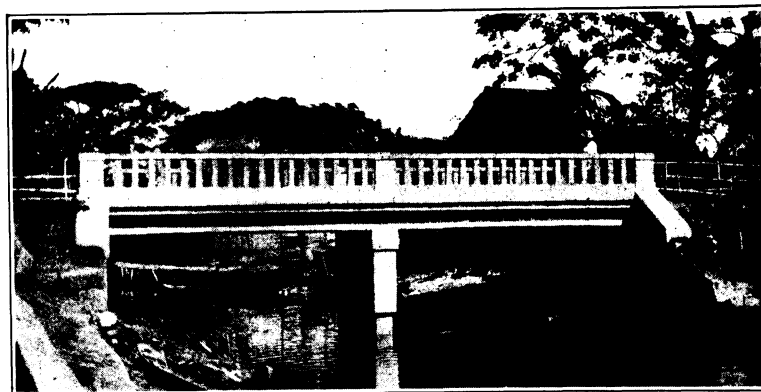
than the probable life of steel structures, if other conditions permit, concrete bridges are erected in the Philippine Islands instead of steel bridges wherever the probable ultimate cost, maintenance included, can be shown to be as low as the probable cost of a steel structure.



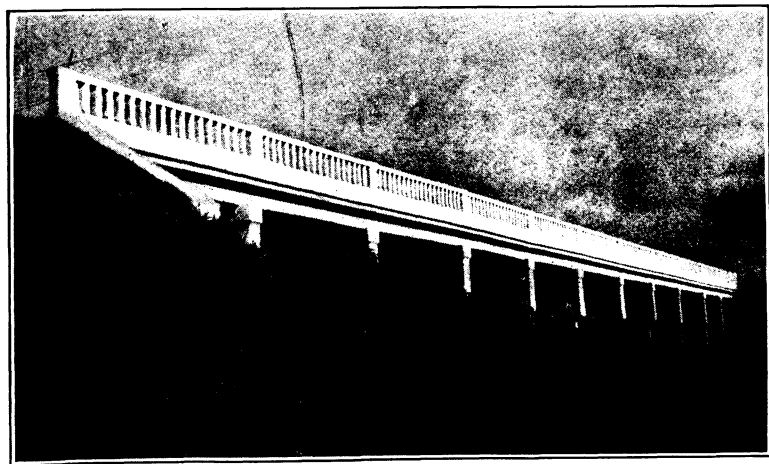
Part of a high bridge showing concrete-pile substructure as it appears in completed units.

The development of a cheap substructure has, therefore, greatly extended the field of the concrete bridge.

The great drawbacks to the rapid extension of this form of substructure, even to the extent of using it to support light steel highway spans are (1) the question as to the permanency of the steel reinforcing in the piles used and (2) the difficulty of securing proper penetration into certain kinds of strata. The writer believes that the concrete-pile substructure has been sufficiently tried out not only here,



A two-span bridge on a pile substructure.



A long bridge built on a concrete-pile substructure. During floods the water rises to the bottom of the caps. This structure has demonstrated the fact that concrete-pile substructures give good results even where high floods with a considerable current are common.

rusts very rapidly. Where steel superstructures are used this means either high maintenance cost or rapid deterioration. Owing to the low maintenance cost of concrete structures and to the fact that the probable life of concrete structures is usually assumed to be greater

but also in the United States and in Europe, to warrant the assertion that it is a satisfactory form of construction but he also feels that before it is as widely or as confidently used as its merits justify, there should be some improvement in the piles themselves, some change in the methods used, and a radical improvement in the equipment required.

PUBLIC WORKS, OLD AND NEW, IN BATANGAS PROVINCE.

JOHN C. CATON 3d, District Engineer, Batangas Province.

The Province of Batangas during the Spanish régime was exceedingly prosperous, due partly to the fact that the earliest Spanish efforts at colonization and exploitation were directed to the towns of this province, and partly to the fact that a large portion of the land is on a high, accessible plateau, and so proved to be suitable for raising wheat and coffee. Before the days of steamers and the Suez Canal, locally grown wheat was a vital necessity for the Spaniards, and the highlands of Batangas Province produced nearly enough of it to meet this demand. From this early start the province progressed steadily in agricultural development, and the consequent prosperity resulted in the construction of a very large number of public works of various kinds. The old bridges over the ravines, the unusually large and well-built churches and public buildings, the numerous dams built for either power or irrigation purposes, and the many privately built two and three storied masonry houses, all tell of a very

active construction program well carried out. This progress was only temporarily retarded by the revolution, and during the past seven years a noteworthy advance has been made in the construction and maintenance of public works. The purpose of this paper is to give a brief synopsis of these works as they exist to-day and as they are proposed for the immediate future.

ROADS.

The road system as laid out during the Spanish days is wonderfully complete. There is, however, a vast difference between laying out a road system and constructing the finished roads on that system. It has been left to the American administration to build and maintain real roads passable the year round. Nevertheless, each and every town in the province, with the exception of Lobo and Calatagan, both situated on the seacoast, was joined to the other by wide dirt roads passable for wheeled traffic during the dry season, and most of them during the rainy season, though with difficulty. The highways in general were unsurfaced, owing in all probability to the scarcity of hard stone within reasonable distances, a condition found with prac-

despite the fact that the last traffic census shows an average of 703 vehicles of various types per day on this section. The plate of a section of Km. 121 shows the road as it appears at the present time.

In decided contrast to the equipment used on this road is that which the province now has available for road-construction purposes. A well-equipped, portable rock crusher crushes the stone formerly broken by hand. Two wide-tired, smooth-tread steam trucks with trailers, in addition to the faithful old bull carts, haul the stone to the work where it is properly placed, watered, and rolled without delay into the finished road. Three rollers are constantly in use during each construction season. One great advantage of using a power crusher instead of the old hand-breaking methods is that it makes available for use the stone screenings so necessary in a properly bound macadam road. Another advantage is that it permits the use of a carefully graded stone in the lower courses of the surfacing; the larger sizes being placed next the subgrade with a course of medium-sized stone, all the same size, on top of this. When properly rolled and bound the result is a roadway that will keep reasonably smooth as traffic wears it down. This is very noticeably not true of



First macadamized road built in Batangas Province, kilometer 121, Batangas-Nasugbu Road.

tically all the roads. The great asset left by the Spaniards is the right of way, which is frequently ample and usually on an alignment that is hard to improve. As an indication of the age of some of these roads, an old local history states that the road from Taal to Batangas was opened in 1779. This road waited one hundred and thirty-four years before it was properly constructed and surfaced with stone.

Under the present administration suitable stone for surfacing has been brought in by water and by rail, and a system of thoroughly modern macadam highways is now well under way. The first crushed-stone road of any considerable length built in the province was the Batangas-Bauan section of the Batangas-Nasugbu Road. These 7 kilometers were built in 1907, of hand-broken stone and without the aid of a road roller. The stone was hauled to the road by a ponderous, road-destroying traction engine and train. It seemed almost a hopeless task to try to put down a broken-stone road without a roller and with that traction engine tearing the stone loose every day, but the surfacing in the end became set up and bound so well that to-day the road is still in a most servicable condition and has never needed to be resurfaced. This efficiency has been maintained, too,

roads built of hand-broken material. The fact that the power crusher makes all this possible at a smaller cost than with the old methods is in itself a powerful argument for its continued use.

The road map (fig. 3) indicates the first, second, and third-class roads of the province as they are at present (June, 1914). All first-class roads are surfaced 4 or 5 meters wide with crushed stone, are built on a suitably constructed subgrade base, and are maintained continuously in excellent condition. The views shown in figures 4, 5, 6 are of typical roads, not specially prepared exhibits. The second-class roads have ample right of way and are passable during the dry season even for automobiles. The third-class roads usually have narrow rights of way, and, since important bridge structures are generally missing, they are practically impassable to autos at all times. The province now has 87 kilometers of first-class road under caminero maintenance, and 123 kilometers of second-class road under gang maintenance. There are also 167 kilometers of third-class road and a very large kilometerage of trails.

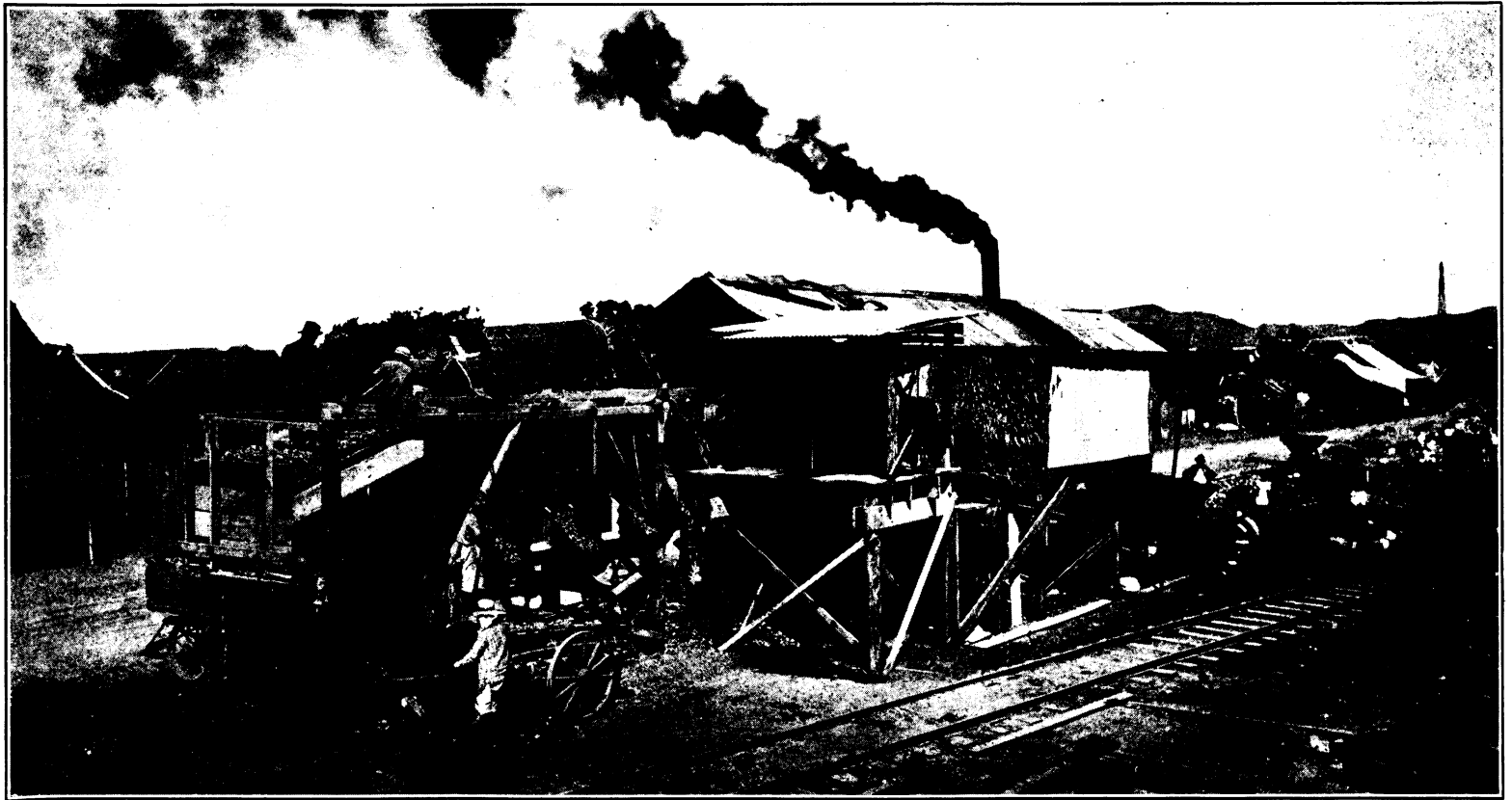
In carrying out the road-construction program it has been the policy to build from isolated towns to their nearest seaport or railroad station, thus giving the towns commercial outlets. This is undoubt-

edly the best policy for the inhabitants concerned, and it will, therefore, be continued. However, as the map shows, the new road system has progressed so far that it is now a connected system, except for three comparatively short sections of second or third class road. It is hoped that these sections, between Lipa and San José, Lemery and Calaca, and Tuy and Nasugbu, can be built within the immediate future, thus giving continuous first-class road from one end of the province to the other. With the construction of an additional 9 kilometers of the highway between Calamba and the Batangas boundary, the province will be connected with Manila by a first-class road system.

In accordance with the policy mentioned, road work is now being carried on in Nasugbu, working toward Tuy, and in Batangas working toward Ibaan. The Nasugbu project will take the road through a wonderfully rich sugar-raising country. Due to the late appropriation of funds only 4½ kilometers of this road were finished during the present dry season. The Batangas-Ibaan project is the first step in a scheme for connecting the municipalities of Ibaan, Rosario, and Bolbok with the provincial capital and the railroad. An extension

massive adobe abutments flanked with rubble wing walls, and the stream flows over an old concrete spillway. The roadways on all three bridges of this type are paved with large square flagstones of Chinese granite. On the main provincial roads there are 101 Spanish bridges and culverts, with a total span of 325 meters and a valuation of ₱150,640.

During the American administration, besides maintaining these Spanish bridges and reconstructing them wherever it was found necessary, 204 additional bridges and culverts of steel or reinforced concrete, with a total span of 516 meters and a valuation placed at ₱315,976, have been built. The province has just completed the construction of what is probably the highest arch bridge in the Philippines, the Sabang Bridge, described in the issue of the Bulletin for April 1, 1914. This structure is an interesting combination, made for economy's sake, of old and new construction materials, the abutments and piers being of adobe masonry and the rest of the bridge of reinforced concrete. The two spans are of 23 meters (75 feet) clear span each, while the curb is 31.60 meters (104 feet) above the



Rock crusher in Batangas, Batangas Province.

from Bolbok to Candelaria in Tayabas Province is also under consideration. The completion of this project will open up a vast rice and sugar section that is at present without outlet for many months each year.

BRIDGES.

The old bridges in Batangas Province are unusual in their number, size, variety of design, and in their permanence. They constitute real monuments to the ability of the Spanish engineers. All the principal structures are yet standing and are being maintained in good condition. Besides the usual arches so common to Spanish countries, there are now in existence, as reminders of pre-American days, four steel deck I-beam, one through steel truss, and three through steel plate girder bridges, all in good condition. An excellent example of the Spanish arch bridge is the one on the Batangas-Nasugbu Road at Km. 119. This bridge was reconstructed in 1911, the concrete apron and spillway having been built at this time, and the adobe abutment repaired. The Spanish steel plate girder bridge in Km. 160, Batangas-Nasugbu Road, is also worthy of note. This bridge rests on

water. The old adobe abutments in Spanish structures of considerable height in the neighborhood give ample proof that this style of abutment and pier will be permanent. The total cost was ₱58,500. The Dacanlao Bridge is an excellent example of an American truss highway bridge. It was built in 1908, has a span of 43.9 meters, and cost approximately ₱32,000.

Bridge construction has now proved so far that the great majority of streams on the first-class and second-class road system are spanned by permanent structures. Of the rivers remaining to be bridged, the most important are the three on the Tuy-Nasugbu Road. Of these the Palico River is the most treacherous and difficult to cross. The provincial board is now making strenuous efforts to secure funds with which to bridge these deep ravines. The Mataywanac and Kaytinga Rivers are to have high 15-meter concrete arch spans, while a steel structure approximately 13 meters long is proposed for the Palico River. With these bridges completed, much of the funds now employed yearly on bridge construction can be used in expanding the first-class road system.

PUBLIC BUILDINGS.

Many old buildings of a public and semipublic nature are still in existence in the province, conclusive evidence of an early period of prosperity under the old monarchical form of government. The old church in Taal, for instance, is an exceedingly large edifice, said to be the largest church outside of Manila. Our picture gives some idea of the size and condition of the façade. When it is realized that from the bell tower of this edifice one may look into the crater of

tions. They are built of locally procured adobe stone, with the exceptions of the treads and the Chinese god decorations, which are of Chinese granite.

The provincial government administration building is an old Spanish structure of ample dimensions. Attached to it as an ell is the building used by the Court of First Instance. The grounds are surrounded by a high wall inclosing bodegas and stables. The entire group of buildings is now valued at ₱50,000. The provincial jail is another well-preserved specimen of the architecture of the old régime.

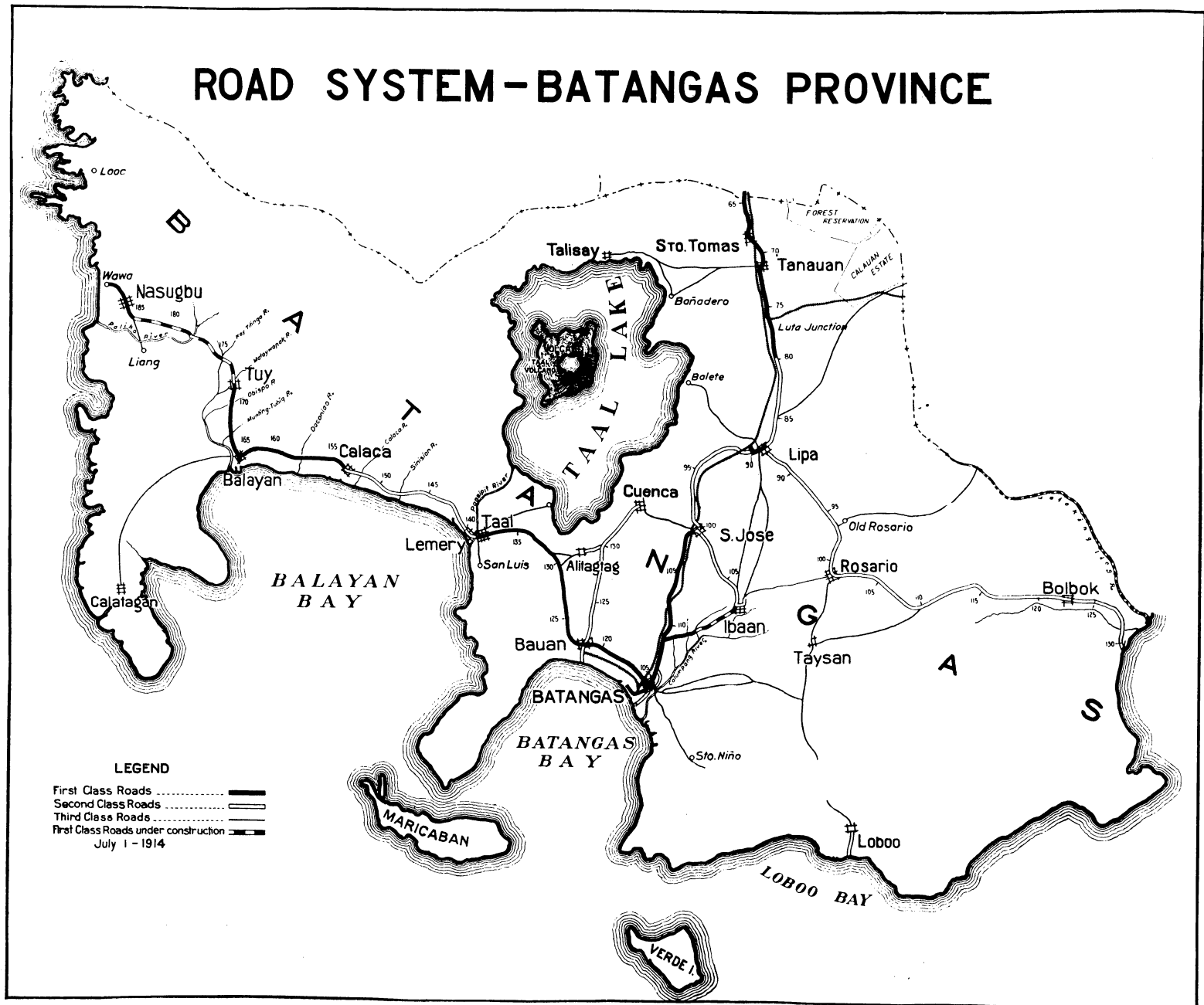


Figure 3.

Taal Volcano and that the church has stood through a number of violent eruptions of this active volcano, it can easily be seen that the edifice must be of the most substantial construction. Construction was started in 1764, the first mass in the new building was celebrated in 1766, the work was finished in 1771, and the church was dedicated in 1781. Through the town of Taal runs a fault line from the volcano. On one side the ground has subsided possibly 100 feet. The former Chinese inhabitants built themselves a church on the lower level and in 1849 joined it to the high ground by the flight of steps shown in the picture. These steps are wonderful, both in design and propor-

It has been entirely reconstructed within and is very commodious and complete in design. The sanitary arrangements are of the best. In addition to the usual separate wards for the two sexes of prisoners and for persons awaiting trial, there is a hospital ward, a leprosy ward, and an entire section is given over to properly housing and feeding the insane of the province. The insane and leprosy wards are entirely separate from the prison portion of the building and have a separate entrance. Special guards are provided for these sections.

The provincial high-school buildings, together with nearly all of



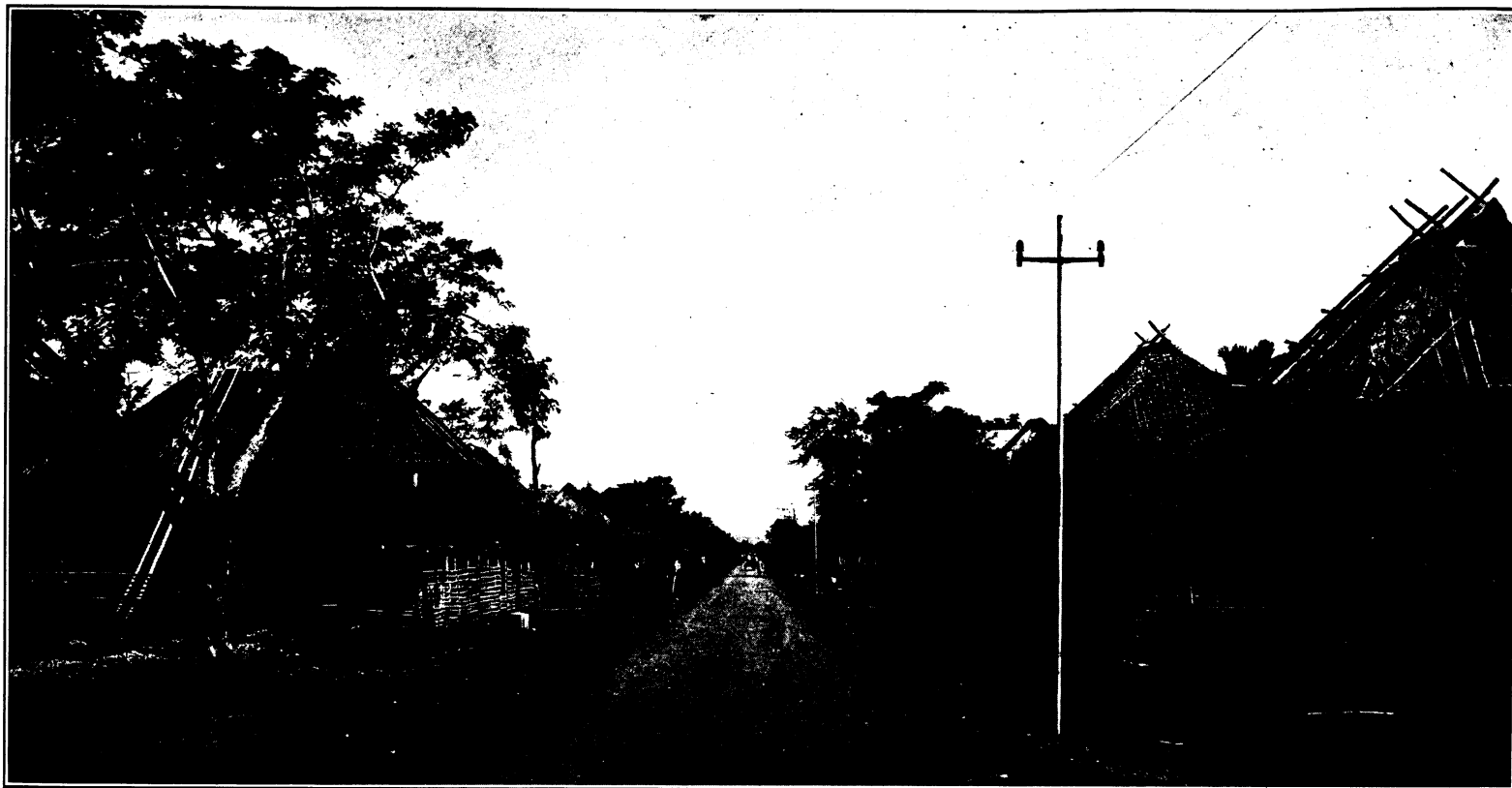
Batangas-Manila Road, kilometer 74, Batangas. (Fig. 4.)

the larger public-school buildings, are of modern construction. The high-school group is certainly a great credit to the province. It consists of three buildings, housing the high school proper, the trade school, and the agricultural and domestic-science schools, and includes the athletic field with its permanent grand stand, all appropriately placed on grounds of ample dimensions. The high-school building has 14 classrooms, a large assembly hall, a library, and an office, and is one

of the few school buildings in the Islands that is large enough to meet all demands that will likely be made on it for years to come. The present total enrollment of students for the entire group of schools is between 500 and 600. As far as athletic grounds are concerned, Batangas should be turning out championship teams. There is a quarter-mile cinder track 20 feet wide, with widened straight-away for sprints; concrete tennis court; a graded baseball diamond



Central street, Tanauan, Batangas-Manila Road, kilometer 71, Batangas. (Fig. 5.)



Batangas-Nasugbu Road, kilometer 186, road under construction, Batangas. (Fig. 6.)



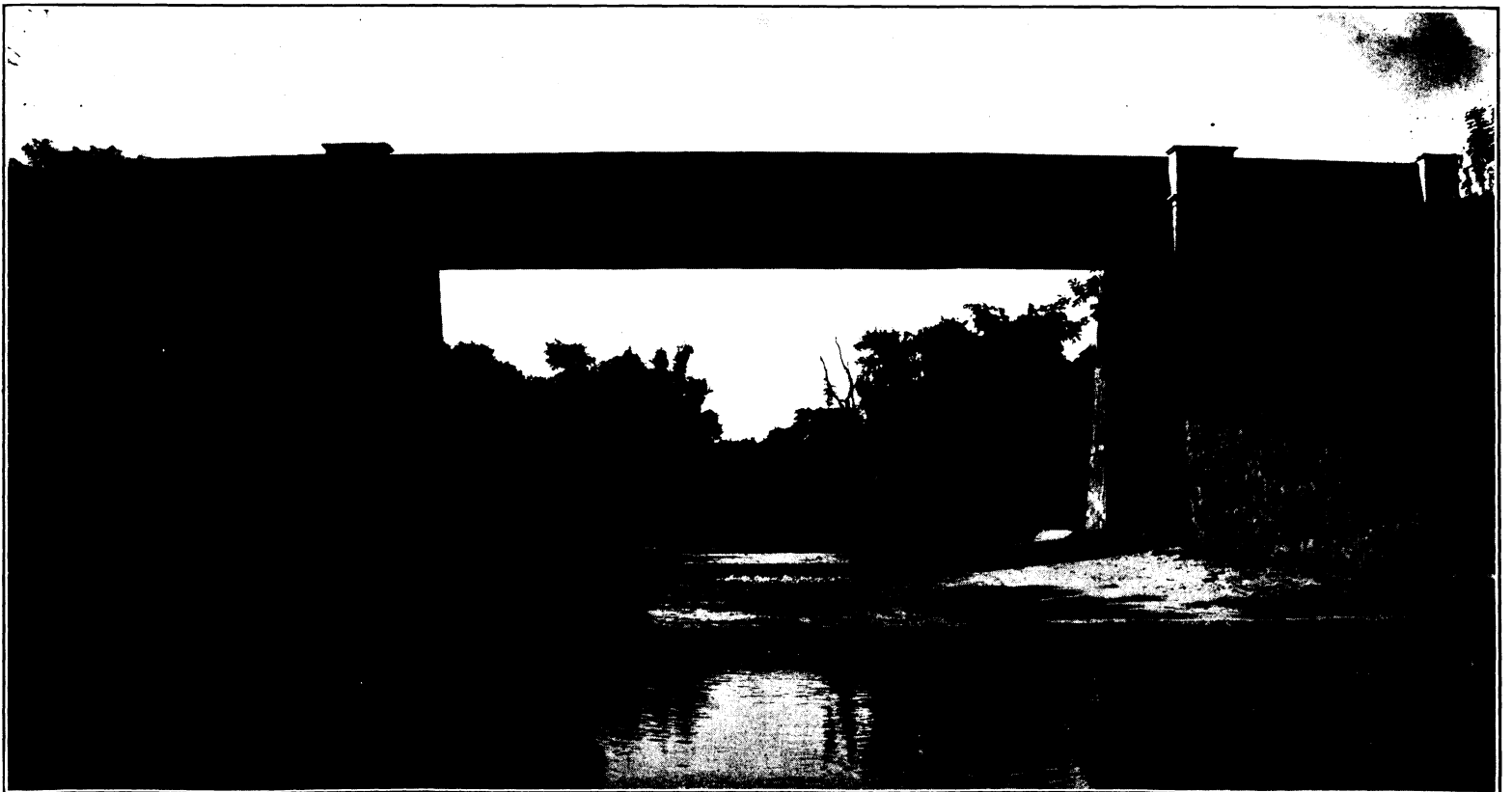
Part of the unimproved Spanish road system, kilometer 116, Batangas-Ibaan Road, Batangas.



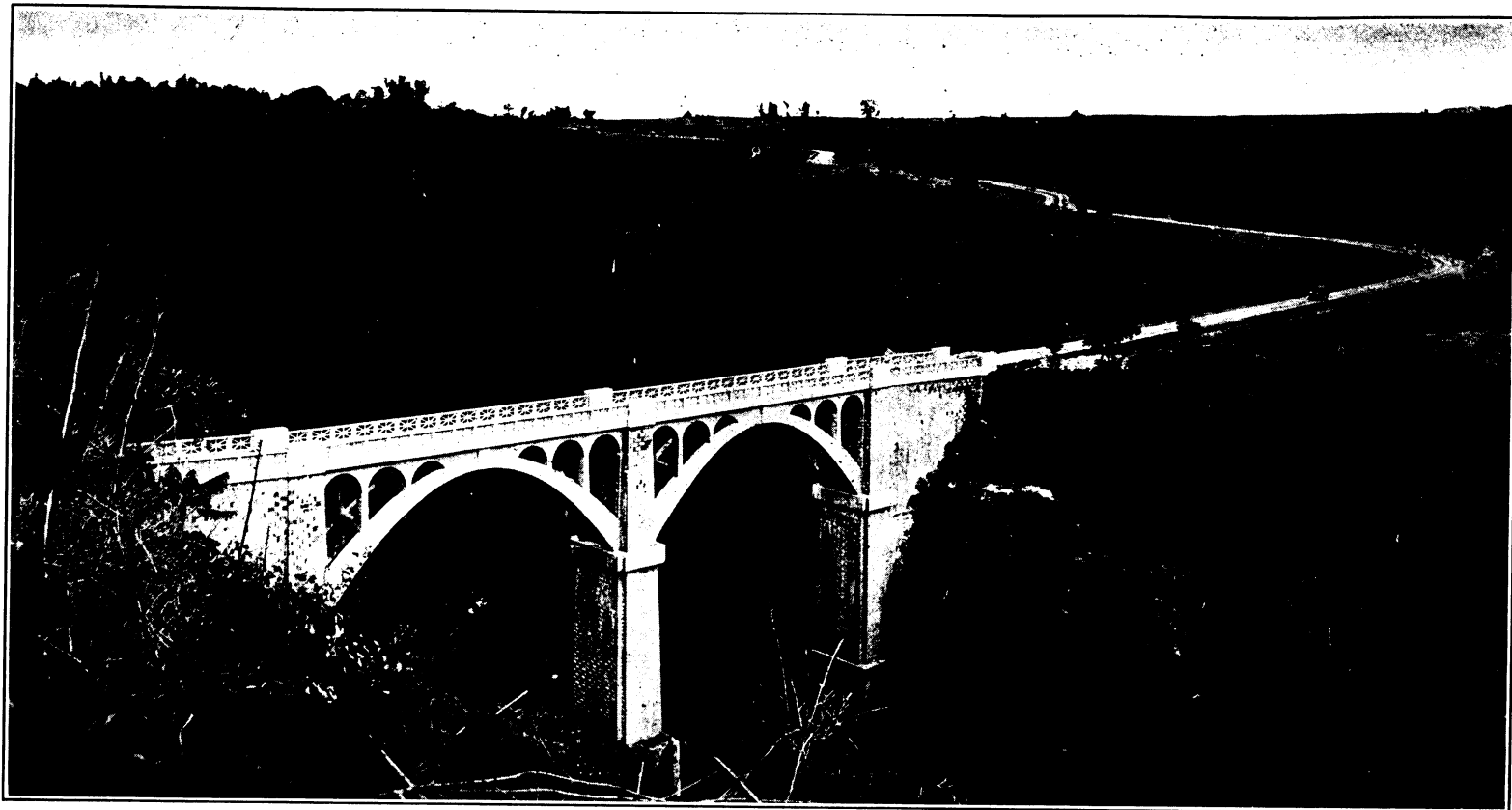
Spanish adobe arch bridge, Batangas-Nagsubu Road, kilometer 119, Batangas Province.

so that the boys can play in wet weather; volley-ball and basket-ball grounds; and all the paraphernalia common in America for track and field events. The grand stand seats 600 and provision has been made for handling larger crowds, without allowing them on the field. The entire grounds are maintained by two "camineros" with the aid of a horse-drawn lawn mower.

Ten modern school buildings have been built in the various municipalities throughout the province in addition to the high-school buildings just mentioned. In all cases except one they are built after the Bureau of Education standard plans for concrete school buildings. The Tanauan building is one of the more recent ones. It is from standard plan No. 7, and was completed in 1913 at a cost of ₱15,611.



Spanish steel-girder bridge with adobe abutments, Batangas-Nasugbu Road, kilometer 160, Batangas.



Sabang Bridge on Batangas-Ibaan Road, Batangas.

The district office now has standard buildings under construction in Nasugbu, Balayan, Ibaan, and Mataas-Na-Cahoy, a barrio of Lipa. Funds are also available for a building in Tuy. The sizes range from the 10-room building in Nasugbu down to a 2-room building for Mataas-Na-Cahoy.

The development of the modern municipal market building, like the present universal distribution of schoolhouses, is essentially an achievement of the present Government. All over the province, wherever new market buildings have been constructed, there have been remarkable increases in municipal revenues from this source and in

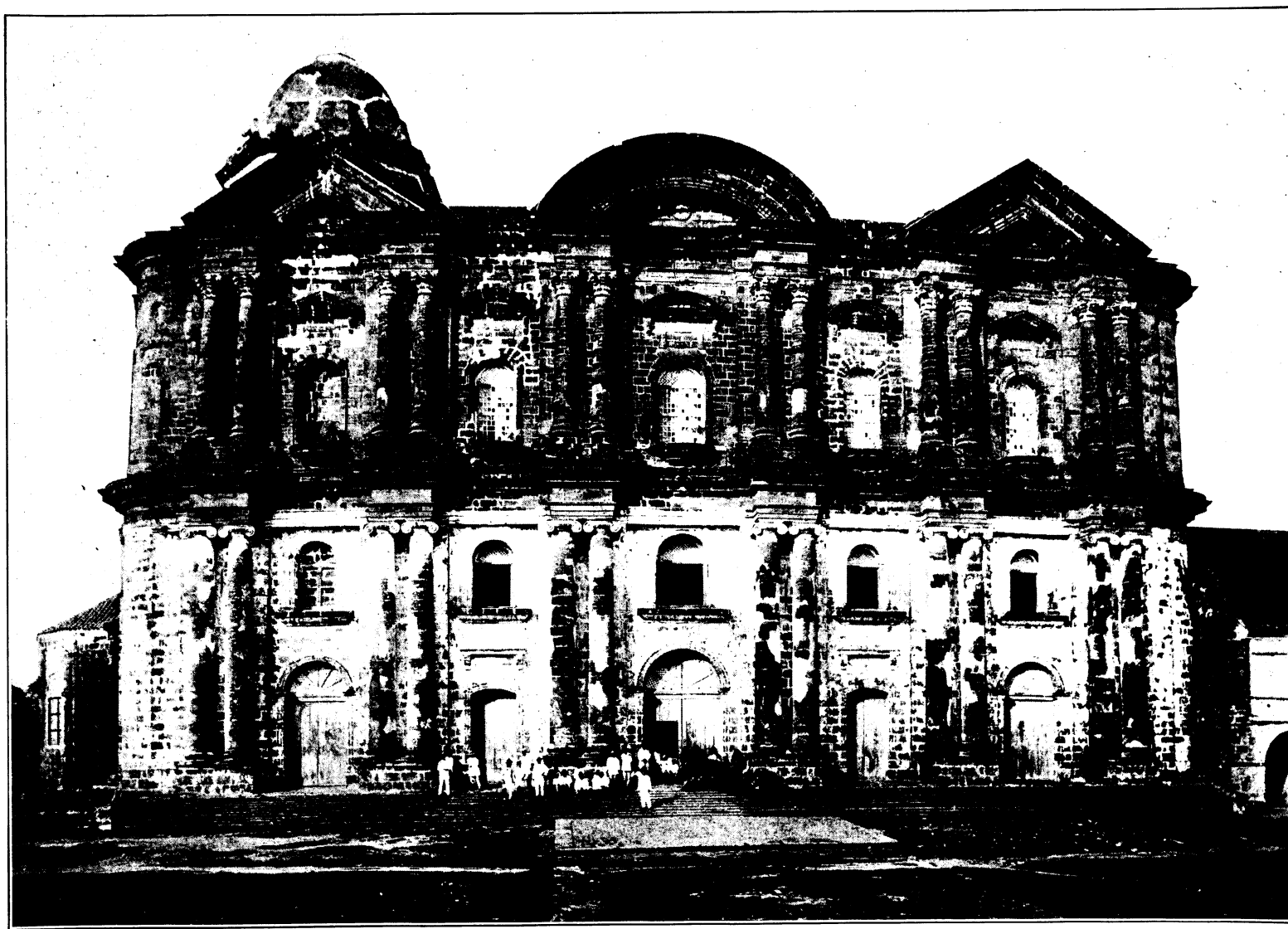


Dacanlao Bridge, Batangas-Nasugbu Road, kilometer 157, Batangas Province.

every instance the towns have taken on a more lively appearance. "Market day" in any of the towns equipped with improved marketing facilities resembles anything but the sleepy, more-dead-than-alive existence so often seen here in the Philippine Islands, as well as elsewhere. On the improved road systems the traffic is several hundred per cent more on market days than on ordinary days, so that there is absolutely no doubt that good roads with good markets make good business for the towns concerned.

The municipality of Lipa has probably the most complete market establishment of any provincial town in the Islands. The local officials take great pride in it and are always working for further improvements. The plant now consists of three main buildings each 21 by 43.5 meters, one block of 10 concrete tiendas, and a concrete

tied on the haciendas and then collected in Lipa, where it is gathered and bought by the representatives of a considerable number of European houses, as well as by a few of the local exporting firms. The tied hemp is shipped to Europe, where it is braided or woven into hats or fabrics. The industry is once more bringing prosperity back to Lipa. This old town was once the center of an extensive coffee-raising industry, and the large warehouses and pretentious two and three story residences with their stables and terraced gardens, now in many instances fallen into a state of neglect and ruin, all testify to the high degree of prosperity attained. The coffee sold in her market yielded at one time an annual revenue of about ₱3,000,000, and this made Lipa the wealthiest town in the Philippines outside of Manila, and the fashionable resort of the best Spanish and Filipino



Taal Church, Batangas.

"matadero," the latter now under construction. All the streets around the buildings have been graded and made into first-class macadam highways, an artesian well drilled, and sanitary arrangements installed. In addition to the slaughterhouse, a decorative steel-and-concrete fence is now under construction. The municipal authorities of Lipa are at present working on a project for installing a steel tank with tower and a power pumping plant over the artesian well in order to have an ample water supply throughout the grounds. The total cost of the buildings to date has been approximately ₱61,000, from which an average monthly income of about ₱800 is derived.

Largely due to the installation of adequate market facilities along with other natural environments, Lipa is now the center of the "tied-hemp" industry, which has become within a very short time the principal industrial resource of the province. The hemp is stripped and

families. Located on a high plateau, it has an admirable climate and is even now visited by outsiders desiring a pleasant change of scenery and air. The entire coffee industry was ruined by a blight which killed the plants, but it is hoped that this recent cornering of the hemp industry for the entire province will once more bring Lipa into her own.

Other towns have shown remarkable improvement after the construction of market buildings. Balayan has a new building 21 by 43.50 meters. It has a concrete floor and columns, supporting a timber roof system and galvanized-iron roof. Immediately after opening this new building the regular monthly revenues from this source jumped 248 per cent, totalling ₱350, and there has been a slight but steady increase ever since. The building cost ₱19,578.

Taal, Bauan, and Batangas also have improved market facilities.

The latter has the greatest revenue-producing market in the province, the monthly rentals being considerably over ₱1,000. This municipality has just borrowed ₱50,000 with which to make a considerable addition to her market establishment. Tanauan also has available approximately ₱28,000 and the land for a new market plant. This work will undoubtedly be undertaken immediately by administration. It is proposed to build first a 30 by 43 meter building, followed by two blocks of open tiendas. Santo Tomas and Lemery have plans under way for new markets, while Bauan is actively negotiating for the funds with which to increase her present plant.

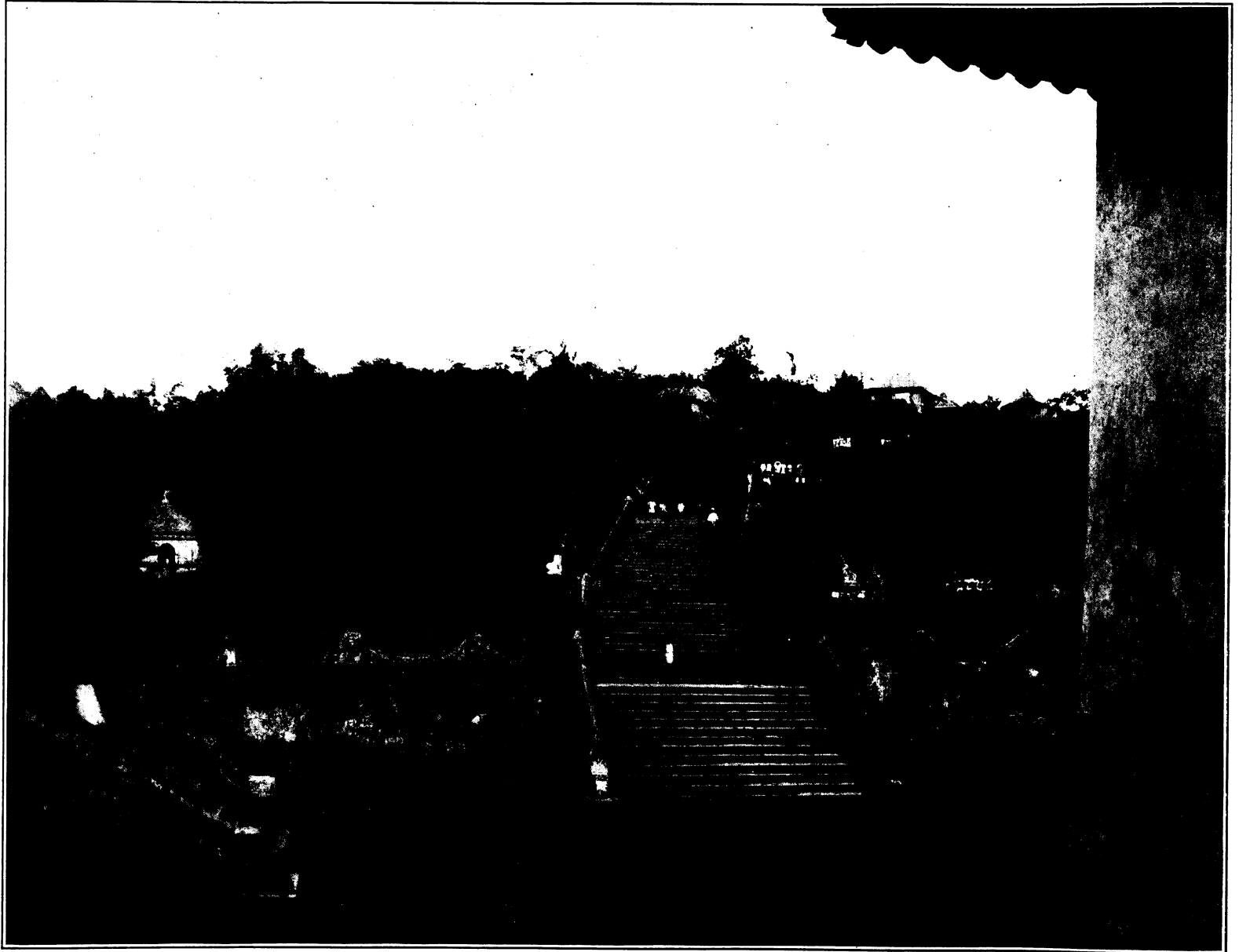
Few of the municipalities of the province have been able to afford suitable municipal government buildings. A number of the larger

adequate setting and a dignified entrance. There are ₱31,750 available for this work, and this sum should prove ample.

Taal boasts an old Spanish municipal government building erected in 1845. It is by far the largest and most commodious municipal building in the province, being 18 by 26.80 meters, and 2 stories high. It has an old Spanish tile roof that actually seems to be rain proof. This building was reconstructed a few years ago at a cost of ₱9,258 and is now valued at ₱40,000.

ARTESIAN WELLS AND WATER SYSTEMS.

The Bureau of Public Works has two deep-well drilling outfits working in the province, while the province and city of Batangas



Old flight of steps in Taal, Batangas. (Built by Chinese.)

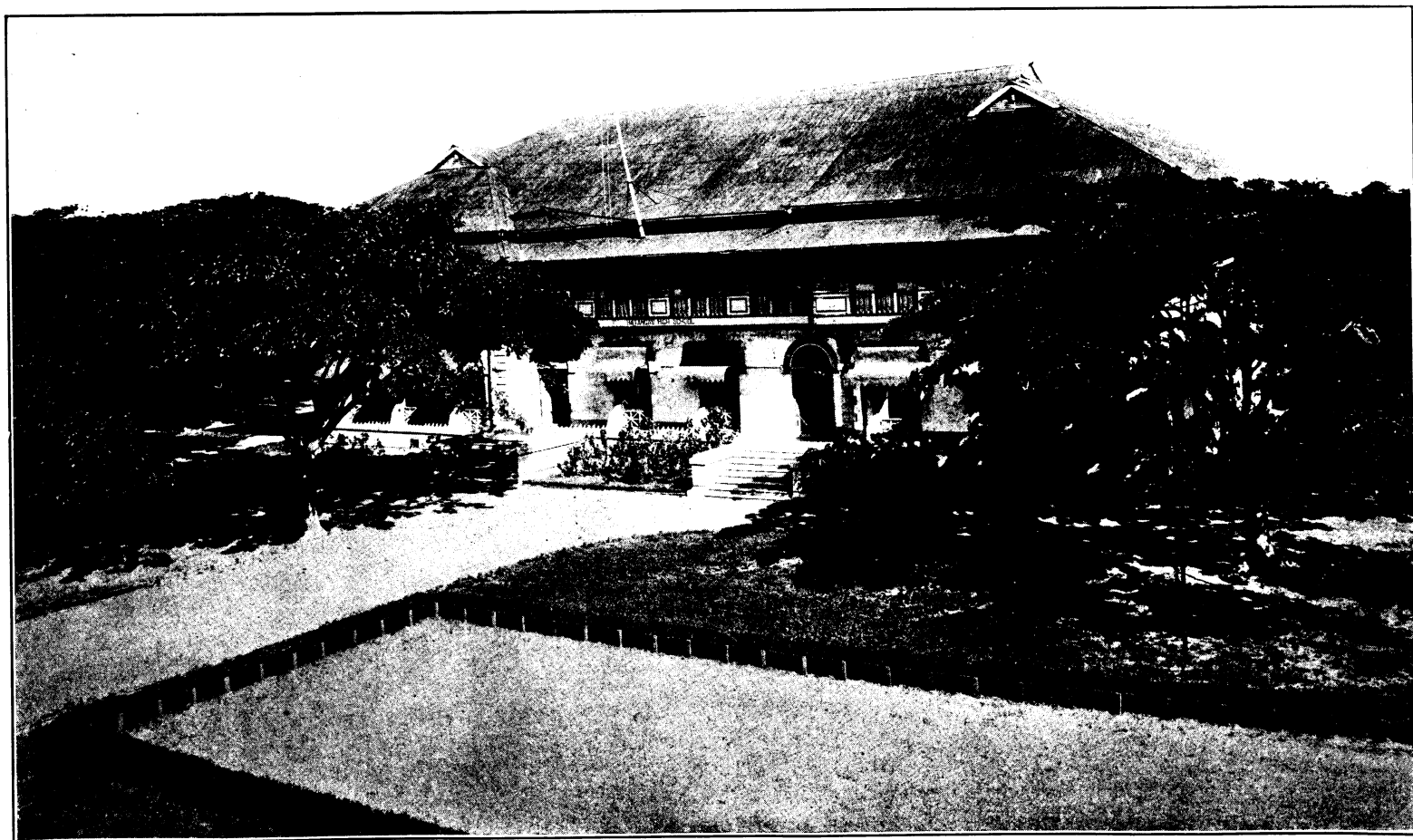
towns rent private residences for governmental purposes. The municipality of Batangas has at present the only strictly modern "presidencia" in the province. It is a 2-story concrete building which cost approximately ₱22,000. The building itself is not only satisfactory in every respect as a home for the municipal government, but the grounds surrounding it have been laid out attractively and are well kept, thus adding materially to the progressive appearance of the city hall. A concrete municipal building of ornate design is now being built by administration for the city of Lemery. The building has been set back some 30 meters from the road, and the space thus obtained is to be parked, by which the building is given an

each own jet rigs for sinking artesian wells. To date, approximately 34 successful wells in 11 different municipalities have been drilled. Most of the wells are in places where the people had to previously depend on river water and in some cases had to descend deep ravines to get it. Others are sunk in sections absolutely barren of water and in still others brackish water had previously been used. In nearly every case a notable improvement in health conditions has followed the completion of each well.

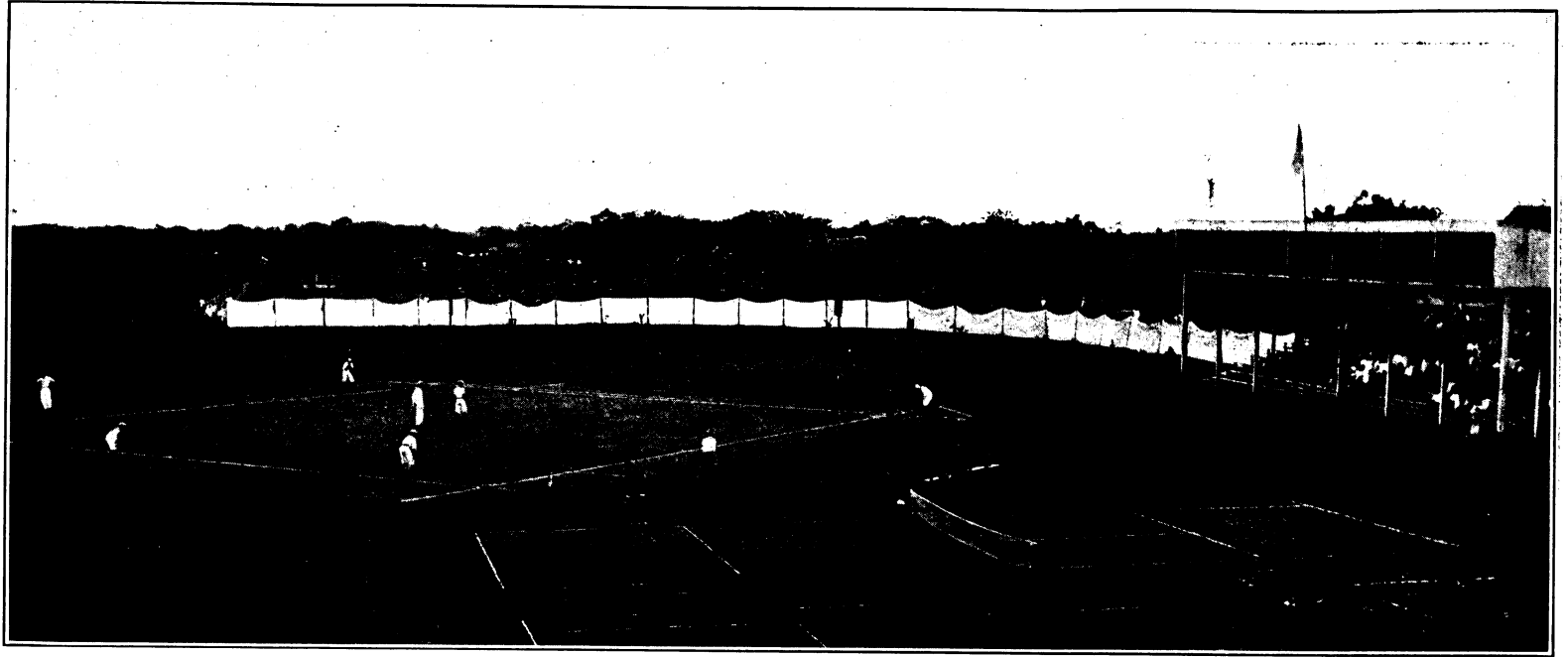
A particularly valuable well is the one on the Batangas-Nasugbu Road, in Km. 133. When this road was under construction in 1913, water for use in binding the subgrade, which during the dry season



Batangas government building, Batangas Province.



Batangas High School.

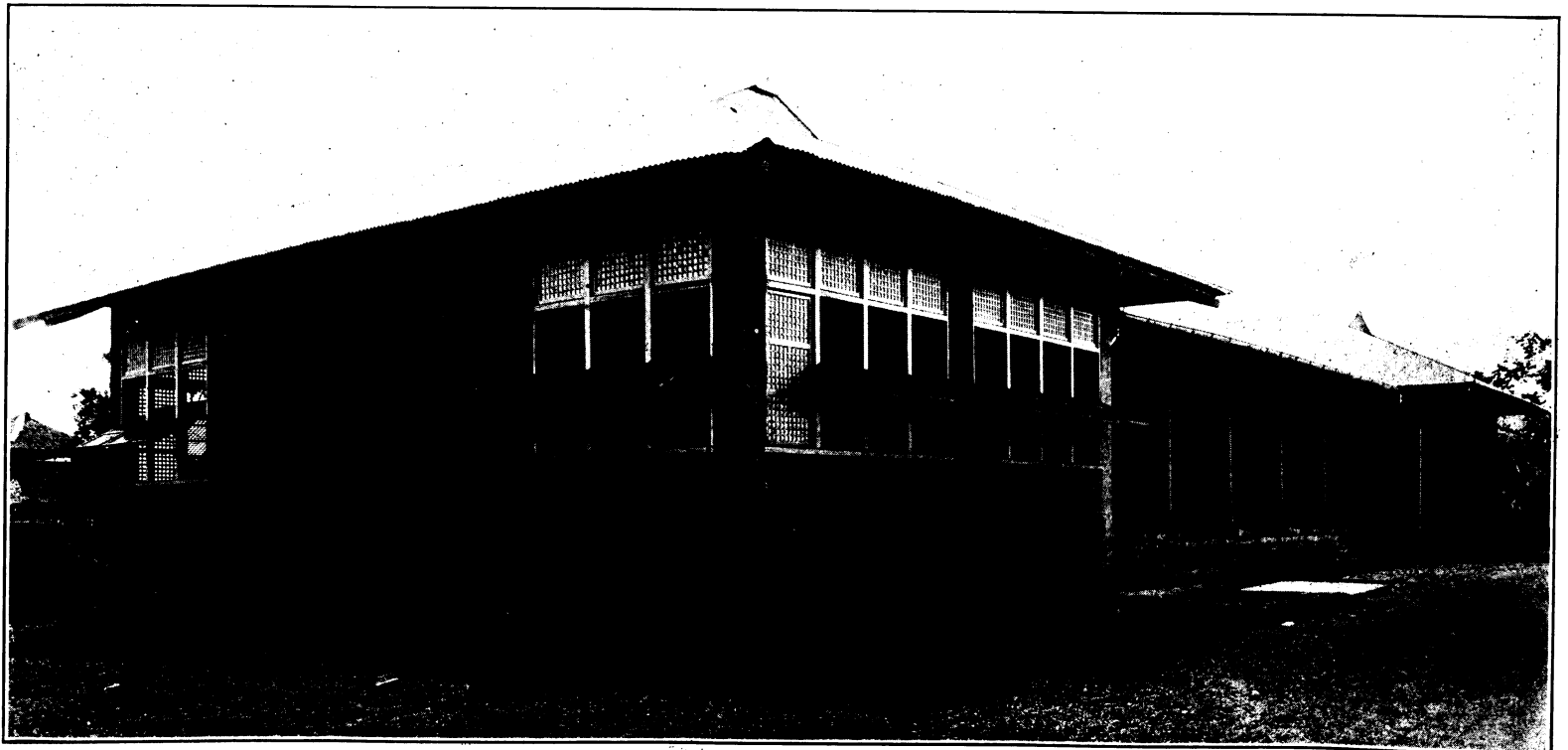


Batangas High School athletic field.

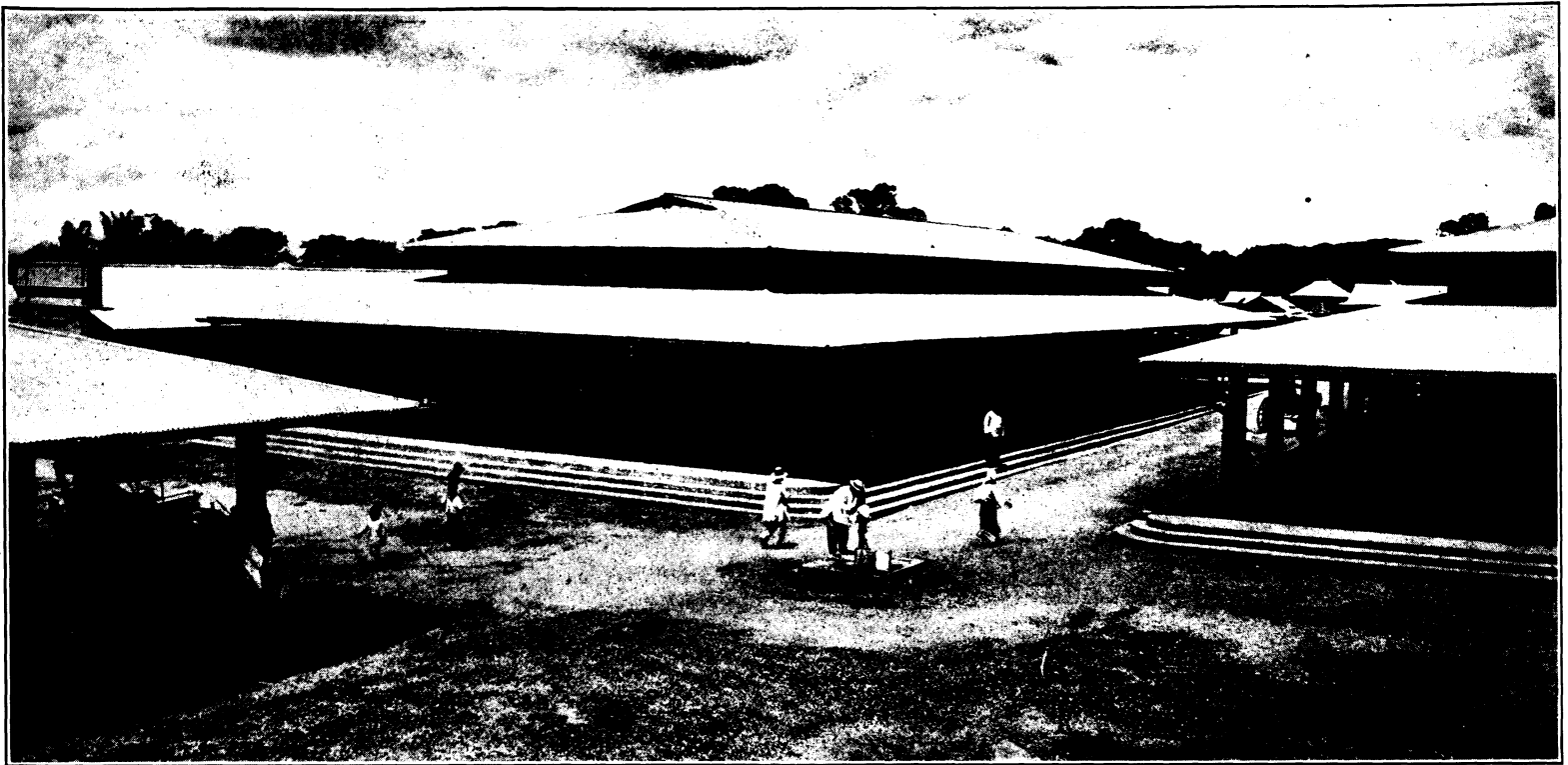
was principally adobe dust after the picks, shovels, plows, and scrapers were through with it, had to be hauled either 8 kilometers over a bad road or 9 kilometers over a good road, and in both cases up hill all the way. It was found to be impossible to get sufficient water at any reasonable cost, so that authority was obtained for using road and bridge funds for sinking a well. When the drill got to work, water had to be purchased at 2 centavos a gallon for pouring into the hole to clean it. After much hard work water was finally coaxed to rise in the hole to within a distance of 325 feet of the surface. After many more vexatious delays, aided by one or two unforeseen accidents, a specially designed pump was finally installed by means of which the water could be raised to the surface. The well did not help the road construction, however, for the simple reason that the road was finished many months before water could

be pumped from the well, but the Filipinos who live thereabouts, and there are a great many of them, reap the benefits. Every time they get a can of water from this well they save themselves either 8 centavos or the work of hauling the water $6\frac{1}{2}$ kilometers uphill from Taal. At sundown each evening scores of people may be seen awaiting their turn to get water at this well.

In decided contrast to this well is the one located right on the beach in the municipality of Bauan, drilled to supply a very populous barrio at the seaport of Bauan. It, too, has its peculiarities, for at high tide it flows approximately 200 gallons per minute while at low water its flow diminishes to only 50 gallons. The head on the well at high water is about a foot, while at low tide it barely reaches the outlet pipes. Despite this fact, however, the water is always fresh, clear, and most potable.



Balayan school building under construction, Batangas.



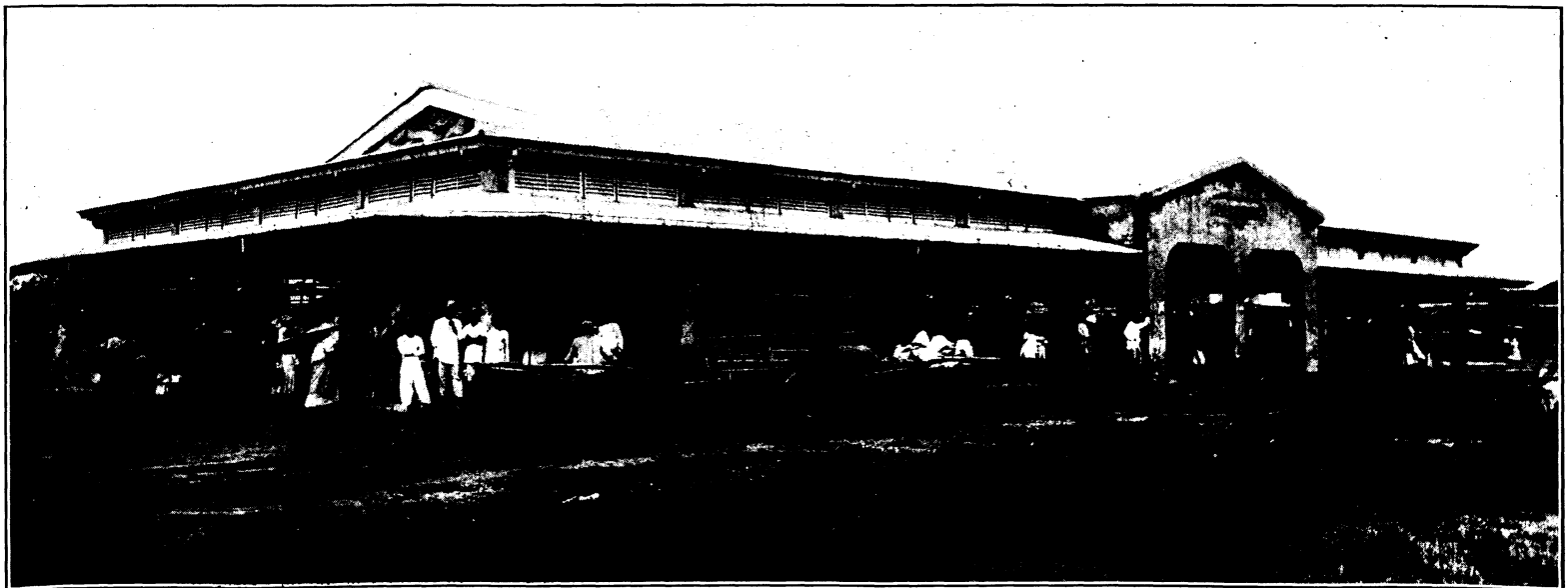
Lipa market buildings, Batangas.

After drilling the successful well on the beach in Bauan, two attempts were made to repeat the accomplishment at the provincial jail, which is situated very near the beach in Batangas. In the first hole put down the drillers ran in about 1,000 feet of casing through a hopeless mass of salt sea, in the attempt to find a hard stratum below. Recovery of the casing proved a most arduous task. At present all drinking water has to be carried 2 kilometers to the jail daily, hence the attempt to give the prisoners a pure water supply close at hand, although a failure, was fully justified.

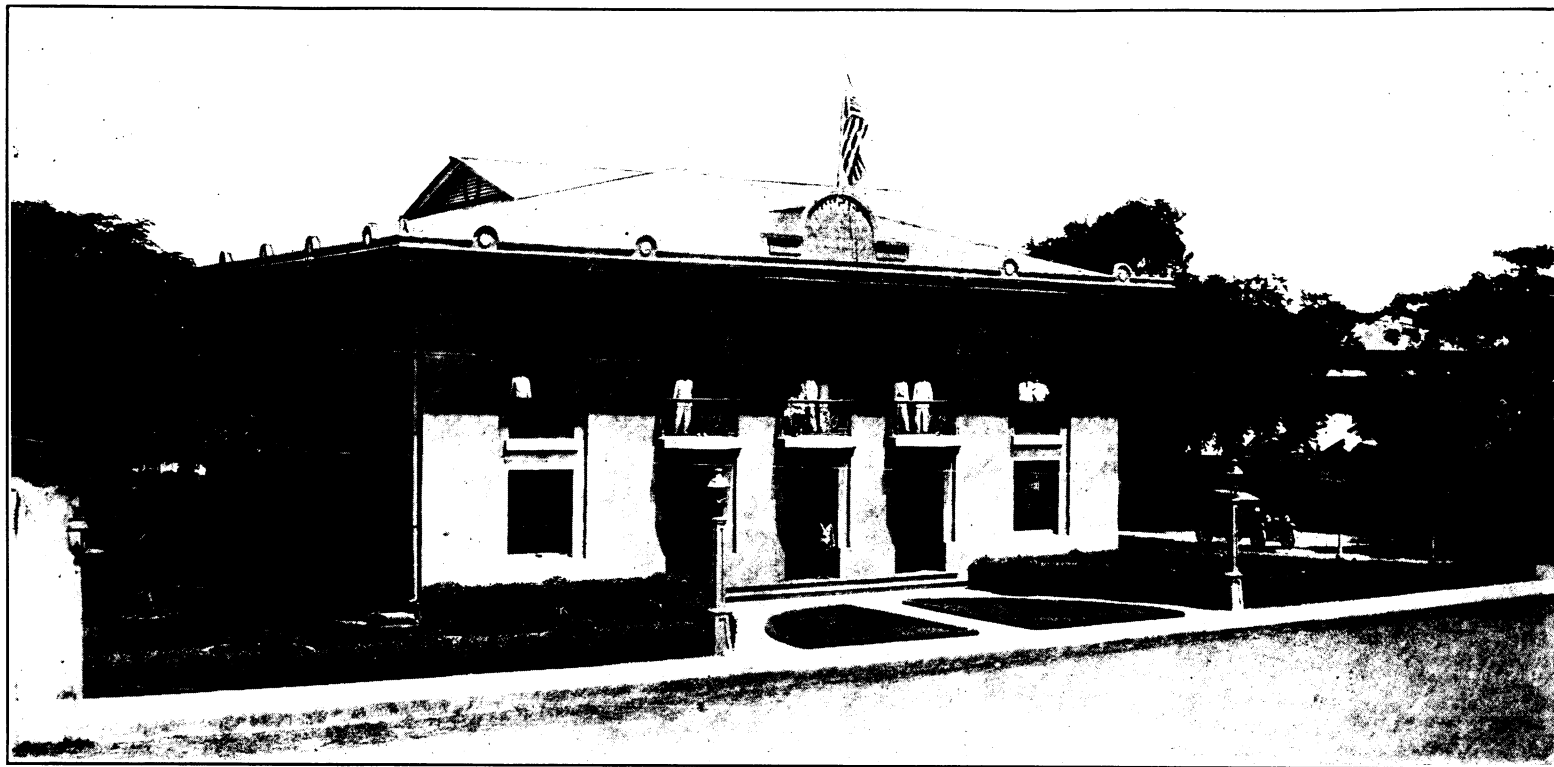
In contrast with the Bauan well, the wells in Balayan flow under high pressure head. On one well the water will rise in a pipe 5 meters higher than the present outlet, and on the other it will rise between 8 and 9 meters. For this reason the municipal authorities of Balayan are exceedingly anxious to pipe the water around the town, the average elevation of which is practically the same as one of the well sites.

The second of the two Bureau of Public Works well-drilling rigs has been working in the province only a short time. It has been sent to a section in which no deep-well rig has ever operated, and has started operations in the town of Bolbok (formerly San Juan de Bocboc), where dysentery has been very prevalent. Great improvement in health conditions is looked for in that town by the district health officer as soon as enough wells are finished to supply the major part of the population.

In the central portion of the municipality of Taal no successful well has ever been drilled, but along the volcanic fault line previously mentioned, numerous springs give an unfailing supply of good water. These springs are located so far from the thickly populated sections that agitation for a water system has long been carried on. For this reason plans have been made and it now seems probable that the system will be built. The estimated cost is about ₱200,000. The project as worked out contemplates that the water from several of



Balayan market, Batangas Province.



Batangas municipal building.

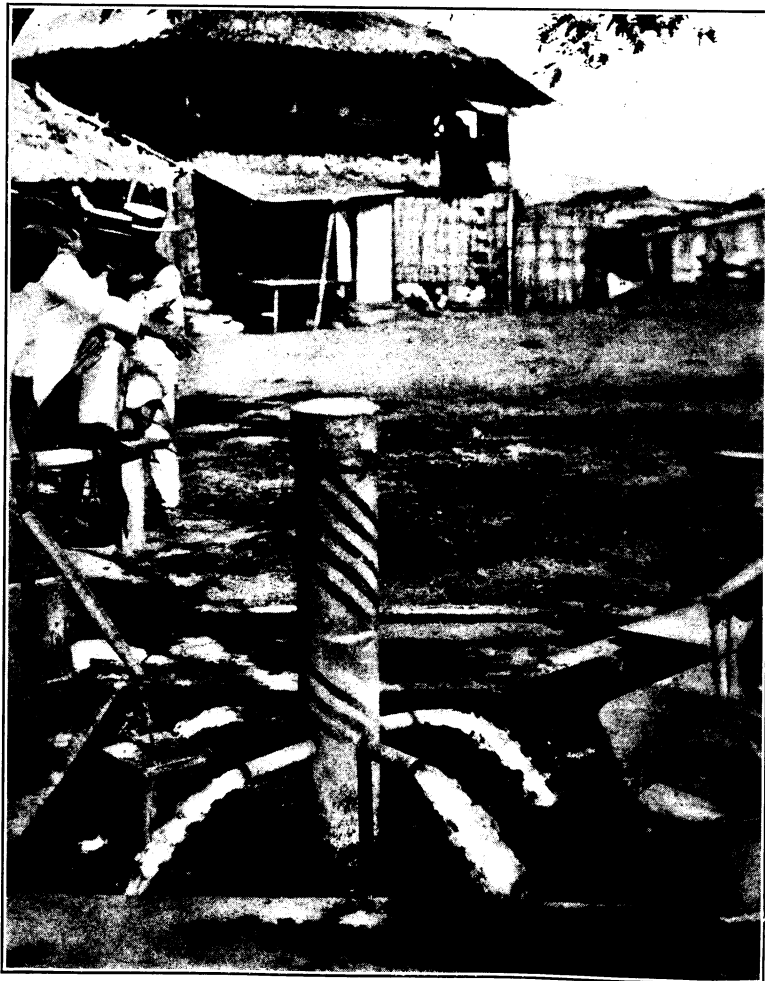
these springs will be piped to a central power pumping plant and from there into the system, the main line of which will run to a large reservoir on the hillside back of Taal. It is proposed to put this reservoir high enough to furnish water for fire protection as well as for ordinary domestic use.

Another small water system in the province is now authorized and contracts for construction are being entered into. A steel tank



Artesian well and pump, kilometer 133, Batangas-Nasugbu Road, Batangas.

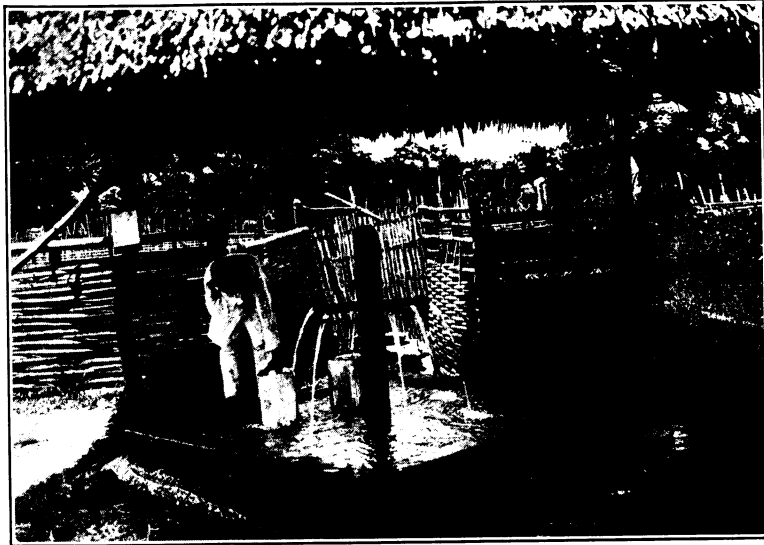
and tower, together with a steam pumping plant, are to be erected over an artesian well in the provincial government building grounds. The water is to be piped from the tank to the provincial building, the provincial jail, the entire high-school group of buildings and grounds, the provincial plaza, the municipal market (if satisfactory arrangements can be made with the municipality), and to such other revenue-producing points as the limits of the supply will permit.



Artesian well on seashore in Bauan, Batangas.

RIVER CONTROL.

An interesting example of river-control work has been completed within the town of Batangas. This work was undertaken to prevent the Calumpang River in its flood stages from eroding its channel into the very center of the town, which at the time the work was started it was apparently in a fair way to do, judging by the amount of property it was taking away every year. The control work as completed consists of four separate parallel dikes which project from



Balayan artesian well, Batangas.

the eroded bank into the river. The dikes are spaced 40 meters apart. They are built of coral rock, each containing about 1,000 cubic meters of material. Two have been strengthened on their stream ends with reinforced-concrete terminals standing on dūñgon piles, the piles being driven into the underlying adobe ledge. The dikes have already withstood a number of floods successfully. The protected bank has ceased eroding and the river has silted up the area protected by each dike

until, at the present time, the water at ordinary stages does not get near the old banks.

GENERAL.

While the Province of Batangas naturally feels a just pride in its achievements, anyone connected with it can easily find room for further improvement. It seems to the writer that the crying need of the province at the present time is more good roads. The large section between Batangas and San Juan de Bocboc is undeveloped, principally because the people living there are practically isolated from the rest of the world for five or six months each year. Very few supplies can be brought in from the outside during this period and it is certain that no crops can be economically moved out. This results in stagnation, when in reality the section should be one of the most prosperous in the Philippines. All this can be changed infinitely for the better by the construction of only 35 kilometers of first-class road. There are other badly needed roads, of course. The amount of traffic between Lemery and Calaca demands even now that these towns be joined by a macadamized road, while all people who have much travel to perform continually clamor for the construction of the San José-Lipa Road. For the increase in economical development and importance which Batangas Province deserves, it is sincerely hoped that the construction of all of these roads may be undertaken in the near future.

ON THE JOB HERE AND THERE.

Mr. Clarence W. Hubbell, formerly chief engineer of the Bureau of Public Works, resigned, effective June 30, 1914, and will leave on July 4 for the United States. Mr. Hubbell does not expect to return to the Philippine Islands.

Mr. F. D. Nash, an old employee of this Bureau and at one time division engineer, is at present located at No. 408 Merchants National Bank, Vicksburg, Miss. He is engaged in private practice in civil and hydraulic engineering.

Mr. O. N. Powell, one of the former district engineers of the Bureau of Public Works, has resigned and accepted a position as junior highway engineer, Office of the Public Roads, with headquarters at Albuquerque, N. Mex.

Mr. J. C. Carpenter is now engaged in road construction with headquarters at Redwood City, Cal.



Dike in Calumpang, Batangas Province.

Mr. Charles F. Kendall, an old-time Bureau of Public Works employee, is now with the Department of Agriculture, Forest Service, district 4, with headquarters in the Forest Service Building, Ogden, Utah.

Former Bureau employees in the United States service are W. A. Crossland, senior engineer in Oregon; Mr. William Burrell, in Iowa; Mr. E. W. James, in Washington, D. C.; and Mr. J. D. Fauntleroy, at one time chief of supervisors, Bureau of Public Works, is in charge of road construction in Virginia with headquarters at Alexandria.

Mr. Gerd H. Shulte, one time district engineer of Rizal Province, is now located at 1545 Amherst Street, Buffalo, N. Y., with the Corrugated Bar Company.

Mr. H. A. Raider has been promoted to division engineer on the Schuenn-Hankow Railway and will have charge of all construction on a 50-mile section.

PROJECT NOTES FROM DISTRICT ENGINEERS.

ALBAY.

During the past quarter the maintenance of first-class roads has been a most difficult problem. To those familiar with this province it is known that there exists very little good surfacing material. Most of the roads are surfaced with a volcanic rock which will not stand up under heavy traffic in the dry season. The increased number of auto trucks, especially the lighter ones with the narrow solid rubber tires, have been the worst menace to the road.

The province has just requisitioned a 5-ton White truck with dump body, similar to those used by several of the other provinces.

The Argus River Bridge was completed and opened for traffic on April 1. This bridge is largely responsible for the greatly increased traffic between the Provinces of Albay and Ambos Camarines, and also for a better mail service. Two trucks are now making the round trip daily between Naga (Nueva Caceres) and Legaspi, a total distance of 208 kilometers, giving a through mail each way every day, whereas before the mail always had to lie over night at Nabua.

A relocation has been made from kilometer 8 to Jovellar on the Guinobatan-Jovellar Road. A location was made several years ago for this road and construction was carried as far as kilometer 8, where it was stopped on account of the heavy grades and the funds transferred. Recently an Insular loan has been secured for the bridges on the remaining portion of the road, and the relocation was made in order to get the proper alignment on the bridges. A maximum grade of 5 per cent against the heavy traffic and 6 per cent with it has been secured. On the old location there were 10 per cent grades in both directions.

On the Legaspi-Tabaco Road the provisional culverts, 11 in all, on kilometer 7 and 8 (lava-bed section), have been replaced by permanent concrete culverts of standard design. The 2 culverts on kilometer 10 are also being built. This leaves only 1 kilometer of the lava-bed section with provisional bridges.

Construction is under way on the Bonga and Matalipni barrio schools, and the two buildings should be completed in July. Material is on the ground for the Estancia building, and the one at San Carlos is authorized. No bids were received for the latter, and the work will be done by administration. San Vicente and Mauraro will be done by contract. The contractor has material ordered, but actual construction has not yet begun.

The Polangui central school, plan No. 7, is well under way. At the time construction was started there were not sufficient funds to complete the building and it was expected to build only so far as the funds would permit, but under Act No. 2359 additional funds have been secured and it is expected to have the building completed by July 31.

The Legaspi market building, standard type A, 24 by 42.8 meters, together with one group of seven double 4 by 5 tiendas, has been completed and turned over to the municipality. This market was opened on June 22, and the change to the new site has increased the traffic over the San Rafael bridge by approximately 5,000 foot passengers per day. About 90 per cent of this increased traffic is between the hours of 6 and 8 p. m., and it is absolutely necessary that something be done to relieve the congestion. Plans are being made for either widening the bridge or for adding sidewalks to either side.

The Tabaco and Guinobatan markets are both well under way. The former should be ready for use by July 31.

During the past quarter the labor conditions in Catanduanes have much improved and the Bato-Viga trail is at last nearing completion. It is now complete as far as the barrio of Oco, and the poor un-

fortunates who formerly had to make the trip over Cantilamo Mountain need worry no more. The new trail crosses the summit at an elevation approximately 300 feet lower than the old crossing, and the summit is reached with a maximum 6 per cent grade in either direction. This, compared with the 60 per cent grades or more on the old trail, makes the new one appear more like a boulevard to the people over there who have spent all their lives climbing up and down those hills.

The well-drilling outfit working in Virac is now on the third well. The first well reached a depth of 1,150 feet with only 4 gallons per minute, whereas the second, only about 400 meters distant, furnishes 180 gallons per minute at a depth of 210 feet.

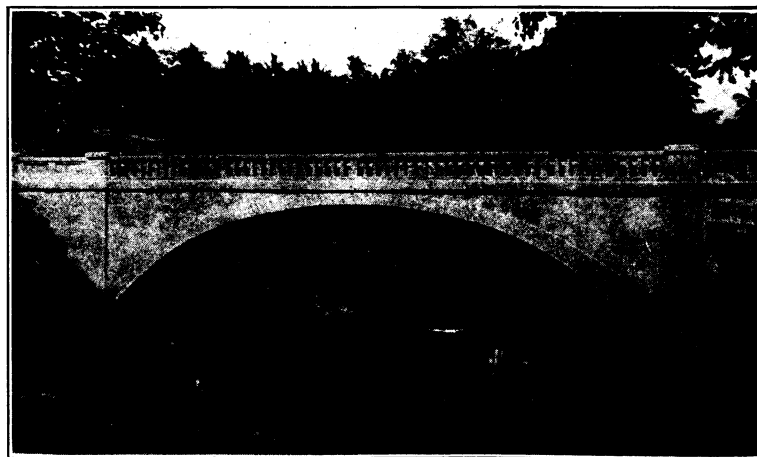
On the afternoon and evening of June 18 the province was visited by a very severe baguio. The total damages to provincial works will not exceed ₱5,000, however, which is very small as compared with the loss of various municipalities and individuals. About 10 kilometers of road on the west side of the province were flooded and all the binder washed out. The damages to the roadbed were slight. The lava-bed section, kilometer 9, Legaspi-Tabaco Road, was washed somewhat, but nothing more than is expected during such a storm. The school buildings at Tabaco and Malinao lost about half their roofs. The contractor working on the Guinobatan market lost considerably in cement and the new concrete columns. The loss in hemp and copra and light-material houses all over the province was very heavy.

AMBOS CAMARINES.

The province recently acquired by purchase the Muñoz property in Naga, which contains two large bodegas and a large strong-material house. The bodegas are being used by the provincial treasurer and the district engineer. The house, which will be used as a provincial hospital and offices for the Bureau of Health, is being repaired at present.

A standard reinforced-concrete culvert 5 by 4 meters was constructed at kilometer 43.6 on the Naga-Boundary Road.

Proposals for the construction of the Anayan bridge, No. 16.4, on the Naga-Boundary Road have been advertised for, bids to be opened July 11. This is a 13.5-meter reinforced-concrete arch. Proposals are being prepared for the Marapon bridge, No. 9.2, a 12-meter reinforced-concrete slab and girder bridge on the same road. With the construction of these two bridges all bridges on the roads leading from Naga will be permanent structures.



Barit River Bridge, Ambos Camarines. Twenty-meter reinforced-concrete arch; total cost, including approaches and surcharge, ₱15,000.

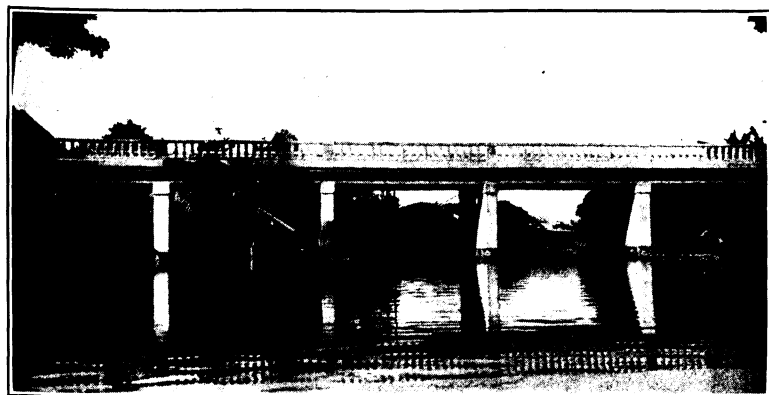
The Santa Cristina culvert, 5 by 2 meters will be completed by July 10.

The road construction carried on during the quarter included the completion of the Bato-Argus River section and the resurfacing of kilometers 1, 2, 48, and 49 on the Naga-Boundary Road. In Partido the Tigaon-Central Road and about 1 kilometer on the Tigaon-Pili Road were completed, and the construction gang is now on the Goa and San Jose Central Road.

Maintenance on portions of sections 1 and 2 of the Naga-Boundary Road has been difficult on account of the heavy automobile truck traffic. In North Camarines the scarcity of good metalling is the most serious question. Heavy traffic on the Daet-Indan Road makes maintenance with present material a difficult proposition. A good quality of rock has been located at Mercedes, but the cost of transportation under present conditions makes it economically unavailable.

Construction of the Iriga market was started June 6.

The Naga market has been recommended by the municipal council to be constructed by administration. Materials have been ordered and work will be started about August 1.



Naga Bridge, Ambos Camarines.

A preliminary survey is being made for a road between Tigaon and Cadlan via Mabatobato. This road is 30 kilometers long, connects the Naga district with Partido, and when constructed will be one of the most important feeder lines for the railroad in this province.

June 18 and 19 a baguio passed through this section during considerable damage to the crops and blowing down a large number of houses. An accumulation of drift, consisting of trees, bamboo, grass, etc., that required several days to remove, lodged at the Naga and Argus bridges, but aside from washing out some of the approaches but little damage was done. The storm occurred at night and was the most severe that Camarines has experienced for many years.

ANTIQUE.

The planting of grama grass along all first-class roads of the province has been completed. All grass except grama was removed from the right of way. Trees of several different kinds, such as mangoes, acacias, santols, nancas, lumboys, and bubogs were set out in May. Coconuts will also be planted on some of the sections near the beach, where they are sure to grow well. It is expected that the coconuts will aid very materially in the future financial support of first-class roads.

The storm during the latter part of May lasted for a week and caused the Antique River to rise over its banks. The principal damage was the washout of 30 meters of kilometer 7, San José-Dao Road.

During the last two months 4 kilometers of first-class road were built complete and 2 kilometers of subgrade made ready for the surfacing. Grama grass is planted on every kilometer after the surfacing is finished, and shade trees are set along the border of the right of way.

Many kilometers of second-class road have been repaired, and the hauling of sugar, coprax, and rice is greatly facilitated thereby. The right of way lines on second-class roads, where same are not liable to change, will also be planted with shade trees as soon as the trees are strong enough to bear transplanting.

Delay in the receipt of cement, due to poor service of the steamboats plying between Iloilo and Antique, has caused a temporary suspension of the construction of Apgahan bridge. The bridge, consisting of a single 9-meter slab and girder span of reinforced concrete, is now 50 per cent completed.

The Lauaan central barrio school of Barbaza, plan No. 3, was completed on May 29, 1914. Total cost, ₱8,200.

One of the squares of the provincial plaza in front of the government building was ceded by the province for nursery purposes. Plants of several different varieties, such as mangoes, santols, nancas, acacias, etc., are already growing. It is expected that by next year this nursery will be able to furnish many trees for the first and second class roads of the province.

Among the people most interested in the beautification of roads in the Islands, Doña Isabel J. de Fontanilla, a well-known hacendera of Sibalom, should be counted. With the help of her children she has gathered 2 gantas of good acacia seeds, which she has presented to the district engineer for planting along the borders of the first and second class roads of the province. Because of this gift, it will be possible, even this year, to have most of the first-class roads lined with trees.

A complete outfit for deep-well boring has been unloaded at San José to drill the five artesian wells requested by the town. Actual drilling will soon be commenced and it is expected that other towns in the province will pass resolutions authorizing the drilling of wells in their localities.

BATAAN.

The construction of the Balanga-Pilar Road has been started and in about two weeks over 1 kilometer was graded and made ready to receive the surfacing material. The grading work was done by the "paquiao" system. The surfacing material is to be gravel from the Talisay River, obtained with a maximum haul of about 2 kilometers. With the money now on hand it is intended to put this 2-kilometer section into a first-class condition.

The construction of the Culis bridge has been finished and there remains but one river to be bridged in order to permit wheeled traffic over the road from the capital to the most northern town of the province throughout the year.

The canal system and minor structures of the Pilar irrigation system are practically completed. Every farmer expects a larger crop this year. At the request of several farmers the system was opened for about a week before the typhoon, and the water was used to irrigate the newly planted rice.

Repairs to the provincial high school at Orani have already been commenced. Due to lack of funds the asphaltting and tile roofing of the azotea will not be taken up this year.

Work on the reconstruction of first-class road is in progress. The previous difficulty in acquiring the 15-meter right of way in the inhabited barrios has now been solved, and in two barrios at least, where the road was formerly but 8 meters in width, the people now agree to have their houses moved in order to have a 15-meter clearance for the roadway. These houses consist of small nipa shacks which take but little work to move. Through an amicable interview with the owners of the different lands in the barrio of Bantan, kilometer 5 on the Balanga-Orion Road, the right of way has been obtained and construction is now under way at that point.

Even those people of Santo Domingo who have been opposed to the widening of the road have now changed their minds, and there will be no more difficulty as to reclaiming the land for the full width of right of way. The only drawback that now exists for this road is the shortage of funds.

BATANGAS.

The Batangas-Ibaan Road has been opened to through traffic between the two towns. This should mark the beginning of a new era in the prosperity of Ibaan. By June 20, 3.4 kilometers of the road had been macadamized. This amount will probably reach 4 kilometers by the beginning of the rainy season, when work will be discontinued until the advent of a new dry season.

Work has been seriously hampered on the Tuy-Nasugbu Road due to a rinderpest quarantine on all sides of the work. Four kilometers of finished crushed-stone road have been built. Work will likewise be discontinued on this road as soon as the rains prohibit economical progress.

The Nasugbu school building, Bureau of Education plan No. 10, has been started by administration. The Ibaan building, Bureau of Education plan No. 3, has been undertaken by a local contractor. The Tuy school, Bureau of Education plan No. 5, will be advertised within a few days; while the Mataas-na-Cahoy building, Bureau of Education plan No. 2, will probably have to await construction until the next dry season on account of impassable barrio roads. The Balayan building, Bureau of Education plan No. 7, with a number of changes to meet local conditions, has been finished by contract at a total cost of approximately ₱16,200, exclusive of the Insular aid surcharge.

The Lemery presidencia building, a standard plan "Scheme A" municipal building, is now well under way by administration. This is to be a 2-story concrete building with concrete floors and iron roofs. Its principal dimensions are 17.50 by 11.50 meters, with an addition in the rear 3 by 9.50 meters. The stairway is to be of concrete with an ornamental wrought-iron balustrade. All woodwork is of the best grade obtainable. Altogether this building should make a most permanent and satisfactory home for the administration of Lemery's public business.

The Tanauan main market building is to be undertaken by administration. This is to be a 30 by 43.50 meters, "no court type" building. It will stand within a stone's throw of the Tanauan railroad station and should therefore be a very busy market, since many buyers for Manila markets come to Tanauan regularly to buy hogs and citrus fruits, principally oranges. With a central headquarters for the carrying on of this business, it should increase greatly in amount, and the municipality is putting itself into a position to command a considerable revenue from the business.

Four new artesian wells have been completed in Alitagtag. The water elevation varies from 135 to 250 feet below the surface of the ground, but the difficulty of pumping this height does not prevent the whole town from securing water from this source. Formerly the people of Alitagtag had to carry practically all of their water from Taal Lake, several kilometers distant and approximately 150 meters below the town-site level.

BENGUET.

Work on the construction of the Naguilian Road was reported 50 per cent completed on the Director's project report for the month of May. About 1,500 laborers per day were employed on the work during the period March 1 to May 31, 1914. Of this number about 1,000 were Ifugaos, 300 Benguet Igorots, and 200 Bontoc and Lepanto Igorots. The labor employed during June will average only about 600 daily. Practically all are Benguet Igorots, due to the rainy season and to the fact that June and July are rice-harvesting months in the subprovinces of Ifugao, Bontoc, Kalinga, etc. Heavy rains during the latter part of May caused small slides from the upper slopes on practically the whole section of the graded road, and have considerably retarded progress on the construction, but no serious damage has resulted. Slides were to be expected, as the upper slopes were left about $\frac{3}{4}$ to 1 with the idea that it would be cheaper to remove material brought down by slides than to cut the banks to the proper slopes in grading. Two mules on drag scrapers have been used very effectively in cleaning off earth slides, but cannot be used to advantage where there is much rock. Due to the scarcity of labor at this time of the year, the road may not be opened for traffic until the early part of next dry season.

It is planned to maintain the Benguet Road to meet the demands of transportation to and from Baguio until the Naguilian Road is opened for traffic, upon which all heavy traffic from the lowlands to Baguio will probably be diverted over the Naguilian Road. Rains have caused very slight damage so far to the Benguet Road during the present season, and traffic has been interrupted only once for a matter of a few hours.

The Benguet Automobile Line has been maintaining a triweekly schedule between Baguio and Dagupan since May 15, 1914, when the Manila Railroad Company began to take up its track between Camp One and San Fabian. Thirty-five cars were in use during the quarter ending June 30, making an aggregate mileage of 95,680 kilometers (up to June 24). The following is a statement of the passengers, freight, and express, including mail, carried over the Benguet Road during the period named:

	April.	May.	June 1-24.	Total.
Kilometers run.....	36,034	39,267	20,379	95,680
Passengers carried.....	3,016	1,812	835	5,663
Freight and express.....kilos.	677,880	633,919	177,636	1,489,435
Mail sacks carried.....	330	375	212	917

The dormitory building for girls at the Bua Industrial School was completed in May at a cost of ₱18,000. The building is equipped with sanitary plumbing, etc., and was erected on the new site for the school, a prominent hill about 600 meters from the present site, locally known as Mrs. Kelly's School. The site is admirably adapted for a school, admitting of the development of athletic grounds, flowers gardens, etc. The old dormitory building is being removed and rebuilt on the new site for classroom purposes.

An 18,000-gallon cylindrical concrete water tank for the Bureau of Constabulary in Baguio has been completed at a cost of ₱2,800. The tank is used for supplying water to buildings on Constabulary reservation and is built 20 feet above the ground in order to supply buildings at a higher elevation. It has two compartments with a manhole between. A 1:2:3 mixture of concrete was used with satisfactory results.

The grading of the Baguio Polo Field has been completed at a cost of ₱5,000. The field has been widened 50 feet and lengthened 200 feet, making it a standard-size field, 600 by 900 feet. Tramway equipment and mules on plows and scrapers were used on the work. About 4,000 cubic meters of rock and 12,000 cubic meters of dirt were moved. Funds were contributed for the work by Ex-Governor W. Cameron Forbes.

The Baguio telephone system and Government Center water supply, owned and operated by the Bureau of Public Works, is to be transferred to the city of Baguio July 1 without cost. The systems will be operated by the city in connection with its electric-light and ice plants and its present water-supply system, which now supplies a portion of the city. This will permit these systems to be operated more economically and will allow a reduction in the cost of the service to consumers.

The construction of the Baguio city sewer system is about 90 per cent completed. Five thousand and twelve lineal meters of 6-inch pipe,

1,540 lineal meters of 8-inch pipe, and 540 lineal meters of 10-inch pipe have been laid, at an average cost of ₱0.09 per meter, and 87 man-holes constructed at an average cost of ₱32 each. Four hundred and fifty-five lineal meters of pipe have been laid in tunnels driven at a cost of from ₱2 to ₱3 per lineal meter. This work was accomplished by contracting it with small Igorot contractors, who are very familiar with tunnel work from experience gained in the mining district. The typical section used was 1 meter wide and about 1½ meters high. Timbering has not been necessary, except at the headings. The longest tunnel required in the system is 200 meters long. This tunnel is not yet completed.

The 150-horsepower Diesel engine installed at the city electric-light plant during January has been operated since February 15 without an interruption and has proved very satisfactory. The output from the plant has averaged 577 kilowatt hours per day with a consumption of fuel oil of 0.06 gallon per kilowatt hour. This represents about 40 per cent greater efficiency than the old steam unit that has been operated at the plant for several years.

The grading of Wright Park has been completed at a cost of ₱7,200. The funds for this were contributed by friends of Ex-Governor-General Wright in the Philippines and in the United States.

BOHOL.

The work of improving the Tagbilaran-North Road from Maribojoc to Calape and from Calape to Inabanga is going on steadily. About 400 men are now engaged making this road better than ever before in its history. An automobile can now reach Inabanga, kilometer 71.

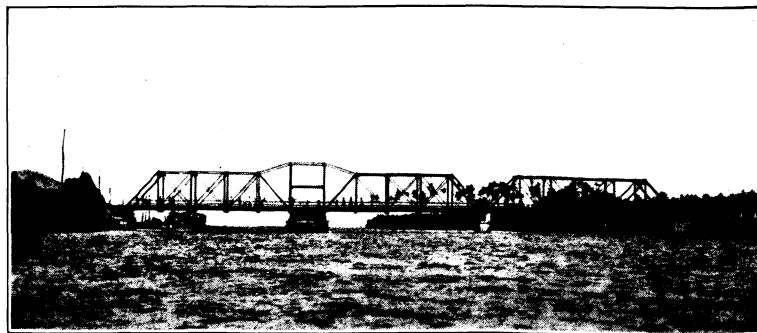


Tangohay Bridge, Bohol. Cost, ₱8,427.09.

Work has just begun on the reconstruction of the Tagbilaran-East Road in the municipalities of Guindulman, Anda, and Candihay. The road near Guindulman is through a very hilly country and it is possible to improve it to a limited degree only. Near Guindulman a relocation is being surveyed in order to avoid the annual damage caused by the monsoon. Work on this new location will soon begin.

All the market buildings authorized to date have been completed. The municipalities of Maribojoc, Loon, Loboc, and Tubigon report very favorably regarding the increase of their market revenues. It is believed that the construction of tiendas will soon be authorized in these municipalities.

The Tubigon school building (plan No. 7) is now fully completed, and the roof has been painted with De Co paint. The Inabanga school building (plan No. 6) is complete with the exception of ceilings and partitions. Money has been obtained to complete the building, and the necessary materials have been ordered.



Loay swing bridge, Loay, Bohol.

The Loay bridge was inaugurated Tuesday, June 9, 1914, with appropriate ceremonies. Miss Urbana Gallardo, the queen of beauty, broke the bottle of champagne amid salvos of mortars and great ac-

clamations from the crowd of spectators. Short speeches were made by various officials, including the Honorable José Clarin, diputado from the Loay district, and the Honorable Fernando Rocha, provincial governor.

BULACAN.

Bids were recently requested for a market camarin at Baliuag. This building is to be of standard design, 30 by 43.5 meters, and was estimated by the district engineer to cost ₱20,000. In view of the fact that the lowest bid, that of the Insular Construction Company, was ₱22,900, the municipal council voted to construct by administration, and therefore active construction work will begin as soon as the materials can be secured.

The foreman in charge of the San Ildefonso school, a standard plan No. 7, has been making very satisfactory progress, as may be observed from the following: Work was begun about the middle of April and has advanced to such an extent that it appears to be certain that the roof will be finished before the 1st of July.

With the receipt of the special allotment of ₱30,000 for the construction of the San Miguel de Mayumo-Gapan section of the Manila-North Road work was actively begun on the project. The railroad has delivered a considerable amount of gravel and somewhat over 3 kilometers of road have been constructed. It was hoped that this road would have been completed before the beginning of the rainy season, but as the rains have begun earlier than usual it appears that at least 2 kilometers of the road must be constructed during the rainy season or else delayed until the next dry season.

Mr. M. E. Martin, contractor, is pushing the work on the Guiguinto bridge in a manner that is very satisfactory. All the piles are driven, all the caps are in place, and some of the slabs have been poured. It is thought that this contract will be completed within the specified time limit.

Since the receipt of the special allotment of ₱50,000 for the construction of the Bigaa-Quingua section of the Manila-North Road, work has progressed rapidly on this project. The allotment became available about the 1st of April and since that time 12 kilometers of subgrade have been constructed, 8 kilometers of first-course metalling laid, and 6 kilometers of road entirely completed. This work is in charge of a Filipino foreman, and both the progress made and the quality of work accomplished are such as to encourage the placing of heavier responsibilities upon native overseers.

CAGAYAN.

The project notes for this province in the last issue of the Bulletin erred in the statement that ₱4,400 was withdrawn from the appropriation for the construction of the Babogan bridge and reappropriated for the construction of the Tuguegarao-Alcala Road. Correctly stated, ₱44,000 was withdrawn from the appropriation for the construction of the Cabagan bridge. Work on the Tuguegarao-Alcala Road, for the construction of which the ₱44,000 was reappropriated, has been progressing satisfactorily, though somewhat slowly, for the last month, as it has been necessary to use the road roller in the construction of an asphalted overflow section on kilometer 10 where considerable damage has been done by the flood water to the embankment every year in the past, since the construction of the road in 1910.

Information has been received that an Insular loan of ₱125,000 has been granted the Province of Cagayan for bridge construction. Of this amount about ₱50,000 will be required for the construction of a reinforced-concrete bridge over Babogan Estero on the Tuguegarao-Aparri Road between Iguig and Amulung. The balance will be expended in the construction of small bridges on this and other important roads in the province. The present policy of constructing permanent concrete bridges on the important roads in the province is continuously rendering the final solution of the good-roads problem in this province less difficult.

The unusually dry weather of the past season caused the first-class road recently constructed to ravel, but by using the road roller after the first heavy rains of the season the damage has been repaired without materially adding to the cost of maintenance.

Three gangs are engaged in the maintenance of second and third class roads. The work is progressing slowly, however, as the labor supply is dependent largely on the barrios through which the roads run. It is with difficulty that the men can be persuaded to work, and even when persuaded they are much less efficient than laborers who have received previous training.

A resolution has been passed by the municipal council of Camalangan authorizing the district engineer to undertake the construction of a reinforced-concrete municipal administration building according to plans prepared by the Consulting Architect. The proposed building is to be a 2-story structure and, in addition to the assembly hall, provides offices for the president, treasurer, secretary, justice of the peace, and other municipal officials. As a matter of economy the beginning of the construction will be delayed for one or two weeks

until the foreman who is in charge of the construction of a primary school building in Peñablanca, and some of the workmen, can be transferred without interfering with the progress of the school building.

The ₱15,000 appropriated by the Philippine Legislature for the maintenance of the Cagayan River has been expended in the construction of a canal joining the estero, which runs through Aparri and along the banks of which most of the river-going boats receive and discharge freight and passengers, with the Cagayan River at a point nearly 2 kilometers above the customhouse. This makes it unnecessary for the river boats to follow the old, shallow, and tortuous channel, which leads from the estero into the Cagayan River so near its mouth as to be very dangerous during rough weather. Indeed, it has been very common in the past for freight boats in attempting to enter this channel from the river, in time of storm, to be swept out to sea and inevitable destruction. However, if much is to be accomplished toward the improvement of the Cagayan—and much is necessary, in order to reduce the cost and difficulties of transportation and in places to protect the towns situated on the banks—larger appropriations will be required in the future. A definite policy of improvement may then be formulated and persistently pursued.

CAPIZ.

Work is progressing satisfactorily on the Panitan-Pilar Road and bridges. The surfacing now extends to kilometer 28, or 13 kilometers beyond Panitan, while structures are complete to kilometer 30. It is expected that additional funds will soon become available, which will bring construction up to the Aranguen River, kilometer 38, by the end of the year.

In view of the scarcity of draft animals and all overland transportation facilities in this province it is interesting and encouraging to note that a new 5-passenger Buick has made its appearance on an hacienda at kilometer 28 on the Panitan-Pilar Road. This promises to be the forerunner of a considerable amount of motor traffic for Capiz.

The Tangalan-Ibajay Road is graded to Ibajay, kilometer 34, and by means of temporary bridges on the last 10 kilometers has opened up the way for wheel traffic to New Washington. Difficult side-hill work at high altitudes was encountered on kilometer 24 to 27, inclusive, but the route presents exceptional scenic possibilities. Funds are now practically exhausted, but it is hoped to complete the road next year.

Work is now progressing rapidly on the Calivo-Busuang Road. The subgrade was completed several months ago and funds have now been appropriated in sufficient amount to construct a 4-meter surfacing with standard section. This road, a tangent of 2 kilometers, connects Calivo, the principal town of the Aclan section, with the beach at Busuang, which serves as a port during the southwest monsoon.

Some 50 kilometers of third-class road have been added to the road diagram for the past half year. Most of this has only recently been opened to wheel traffic through the expenditure of a small amount of money for maintenance.

The Romblon coal storehouse was completed early in May by Contractor George Studier at a total cost of ₱9,951.26, including cost of plans and surcharges. The work was completed in a thoroughly satisfactory manner and represents good workmanship. The building has a concrete floor, concrete walls 1.80 meters high on sides and rear, and a roof of galvanized iron on wooden roof trusses supported by concrete columns. The floor space is 225 square meters.

A considerable amount of interest in tree planting along first-class roads is evidenced both by local officials and employees. Camineros are gathering seeds of approved fruit trees which they set out in their own yards near their respective sections. The saplings will be transplanted systematically when they attain the proper growth. On a number of kilometers trees have already been set out and are doing well.

CAVITE.

The sum of ₱8,300 has been appropriated for the reconstruction of the provincial streets through the town of Cavite and to build concrete sidewalks on each side of Calle Trece Martires. Six thousand and three hundred pesos is the percentage of cedula collections that has accumulated during the last five years to the credit of the municipality, and ₱2,500 is appropriated from the town funds. The latter sum is to be used for the construction of the walks. The street is approximately 6 meters wide, 4 meters for surfacing and 1 meter on each side for sidewalks. A concrete curb 15 centimeters thick and 50 centimeters deep will be laid in 2-meter sections, after which 10 centimeters of 1:3:6 concrete, with a 2.5-centimeter finishing coat of 1:2 cement and sand, will be placed behind the curb for the walk. The street itself is in a frightful condition at present. The surfacing, placed about five years ago by the municipal authorities, consisted originally of approximately 10 centimeters of broken stone, but the material was bound with sand only and was never rolled. The present scheme is to take up the old stone and to roll the subgrade thoroughly,

then to replace the old stone with about 5 centimeters of new Los Baños stone on top, using second-class sand as filler and finishing with stone screenings. This street is a part of the continuous road from Manila to Cavite.

During this rainy season it is proposed to build the section of road 1,200 meters long through what is known as Dalahican tide swamp at kilometer 30 from Manila. The railway lies on the outside next to Manila Bay, while on the inside the road will be exposed to Bacoor Bay—both very rough during typhoon weather. The embankment will be constructed by building two dikes, one on each side of the right of way, each with a top width of 2 meters, outside slopes 2 to 1 and inside slopes $\frac{1}{2}$ to 1. The width between the inside top edges of dikes will be 4 meters. This space will be filled with sand up to within 30 centimeters on the top of the dikes, and the remaining space filled with good material that can be readily rolled and on which broken stone can be laid. The embankment will be allowed to settle before any rolling is done. The total length of this road project is 9 kilometers, from Noveleta to Cavite, but by building this Dalahican section, the whole distance will be open to automobile traffic from Manila. The total distance from Manila to Cavite is 35 kilometers, of which only 7 will be second class.

By the end of May 1.3 kilometers of the road from Zapote to Bacoor had been built as first class with 15 centimeters of broken-stone surfacing 4 meters wide. The sum of ₱30,000 is required to finish the road, and this amount will probably be secured in sufficient time to complete the road during the next dry season. The full 15-meter right of way has been secured. This necessitates the moving of over 80 houses and the acquisition of land from some 250 lots. The province moves the fences back to the new lines and does all work in removing the houses, paying for any valuable trees, bushes, or growing crops. The owners have all given the land free. The only complaint made was by the church authorities of Bacoor, who desire pay for some 40 square meters of their ground. A new concrete bridge with a total span of about 28 lineal meters will be built at the Cavite-Rizal boundary over the Zapote River. Complete new alignment has been secured for the approach to the Banalo steel bridge and the railway crossing, thus eliminating four 15 to 18 per cent grades and four curves of very short radius. This is the last remaining section of bad road between Manila and Silang, and its completion will open up a continuous stretch of excellent first-class road 50 kilometers long.

The Julian Bridge on the Zapote-Bacoor Road has been completed. It is a concrete arch with a clear span of 13.5 meters, the roadway being carried on six spandrel arches. The footings are down 1.5 meters below stream bed on good adobe, with curtain walls down 50 centimeters deeper. The bridge was completed at a cost of approximately ₱10,000, and was built with a native foreman in charge. This structure replaces the old Spanish adobe stone arch bridge which was undermined by floods in September, 1912.

A steel bridge of 80-foot span has been contracted for with the Atlantic, Gulf and Pacific Company of Manila for ₱7,300, to be erected on old adobe abutments across the Grande River in the town of Naic. The present structure has a pier in the center and two wooden spans. These are to be torn out and the steel span substituted. This work will be done in connection with the construction of the Naic-Indang Road.

The Naic-Indang Road was under construction from March 1 to June 1 of this year and 4.2 kilometers of the surfacing, from station 6+440 to station 10+643, has been completed this year. The sum of ₱25,000 was available and the surfacing materials were already on hand. Approximately 8.5 kilometers remain to be constructed before reaching Indang.

A Bureau well rig has done very good work in various towns this last quarter, four successful wells having been completed in the municipalities of Noveleta and Kawit.

CEBU.

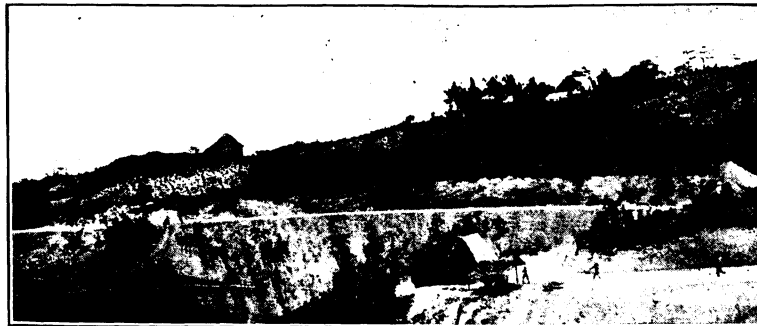
A new section of subgrade has been let by contract on the Cebu-North Road. The material moved will be classified as earth, yeso, loose rock, and solid rock. The section let consists of the heaviest part of the work and its completion will enable wheeled transportation to reach the interior of the island. The contractor is working about 500 men and expects to complete the section by September 1.

The Toledo-North Road subgrade, north of kilometer 73, has been completed by contract to the Guinabasan River. Here the location leaves the coast and follows along the river bed to a broad valley about 3 kilometers inland that parallels the coast. The river bed itself will be used as a road until subgrade work on the side hill adjacent to the river is completed.

The subgrade work on the Barili-South Road has reached kilometer 85 and will probably not be carried any further south, at least as continuous construction. This work also is being done by contract.

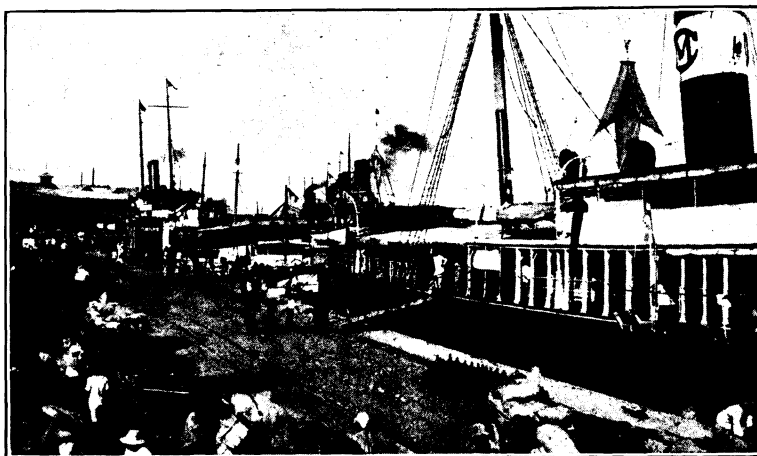
In reference to the subgrade contracts it might be well to invite attention to the prices prevailing in Cebu. A great deal of encourage-

ment was required to start local contractors bidding on this type of work and it was not until about March, 1913, that any such jobs were



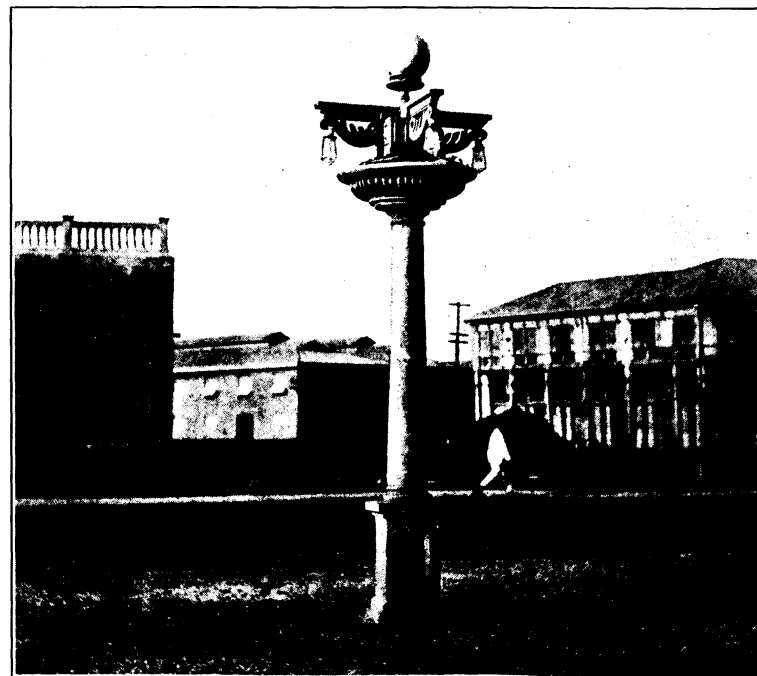
Completed subgrade Cebu-North Road.

undertaken. The first contract price called for ₱1.75 per meter for solid rock, ₱1.125 for guiso, and ₱0.40 for earth. In this work the



Shipping in Cebu Harbor.

province furnished all explosives and tools. The last contract was let at ₱1.19 for solid rock, ₱1.09 for loose rock, ₱0.89 for guiso, and



Concrete lamp post, Cebu.

₱0.39 for earth, the contractor to furnish his own explosives and tools and backfill after the road roller on all embankments. This particular

work does not involve any large quantities. It may be that subgrade is being built as cheaply as the above elsewhere by administration, but when the saving in the salary of the paymaster, the depreciation on tools, risk assumed by the Government in blasting operations, and other such incidentals are considered, it appears that letting work to local contractors is advantageous.

Schoolhouse construction has consisted in the completion of the 2-room Basac school by administration and the 4-room Pinamungajan school by contract. The 4-room buildings at Aloguinsan and Tuburan are well under way and construction has been started on one of the same class of buildings at Toledo. Bids have been requested for the construction of a 20-room building in Cebu City.

Preparations are being made to surface the new Cebu wharf with asphalt-bound macadam. The wharf was constructed by the late Bureau of Navigation to relieve the congested shipping conditions in Cebu, but it has not been used on account of the lack of surfacing. The photograph gives an idea of the number of ships that use the docks. At the time the picture was taken there were 12 steamers tied up alongside the wharf and 8 anchored in the stream waiting for a berth.

ILOCOS NORTE.

The prize bridge has been completed during the last quarter by administration at a cost of ₱8,843.98, exclusive of Insular aid. The wooden piles for this bridge were driven by two jet well rigs. The jet rigs work fairly well in clay soil provided it is not necessary to



Construction of concrete and asphalt overflow section, Laoag River. (Ilocos Norte.)

use a follower. The latter, used even for 2 meters, may double the cost of driving. The following tabulation gives the itemized cost of the bridge for comparison with the estimate.

	Excava- tion.	Piling.	Concrete.	Filling and rolling.	Miscella- neous.	Total.
Labor	₱302.29	₱1,494.01	₱1,076.64	₱119.91	₱127.20	₱3,120.05
Materials		825.69	3,916.95	39.39	16.79	4,798.82
Miscellaneous	7.85	124.60	252.62	4.70	13.20	402.97
Total, exclusive of sur- charges	310.14	2,444.30	5,246.21	164.00	157.19	8,843.98
Surcharges ^c	19.47	153.42	329.22	10.24	9.79	522.14
Totale	329.61	2,597.72	5,575.43	174.24	166.98	8,843.98
Insular aid						616.10
Total cost						9,460.08
Estimated cost ^d	482.00	1,824.00	6,283.52	112.00	362.50	9,064.84
Per cent to estimated cost ^e	64.5	113.4	83.4	146.2	43.4	91.9

^a Mixing and placing	₱324.56
Reinforcing	173.87
Making, setting up, and removing forms	578.21
Total	1,076.64

^b Cement	1,830.30
Reinforcing	745.67
Sand and gravel	684.60
Miscellaneous	656.38
Total	3,916.95

^c Exclusive of Insular aid.

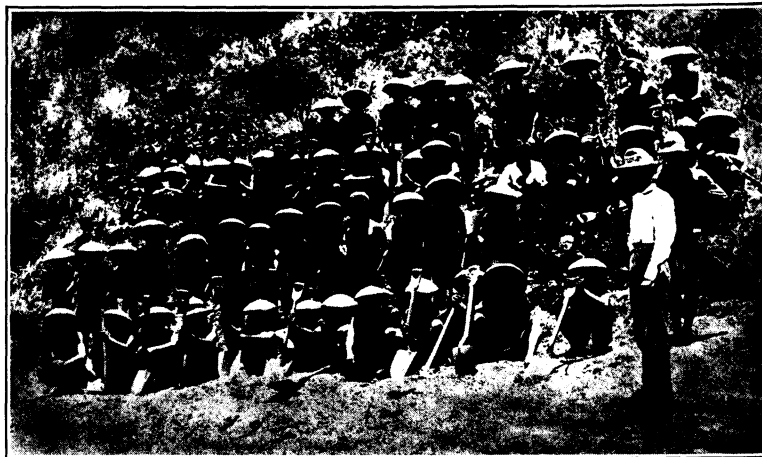
^d By designing division.

^e Actual to estimated cost.

The Laoag and Bacarra bridges were completed during the month of June. Work on the Bacarra school has been resumed. It is hoped to inclose the building with the funds now available. Work will soon be commenced on the Batac market. The Laoag market will also soon be under way.

ILOCOS SUR.

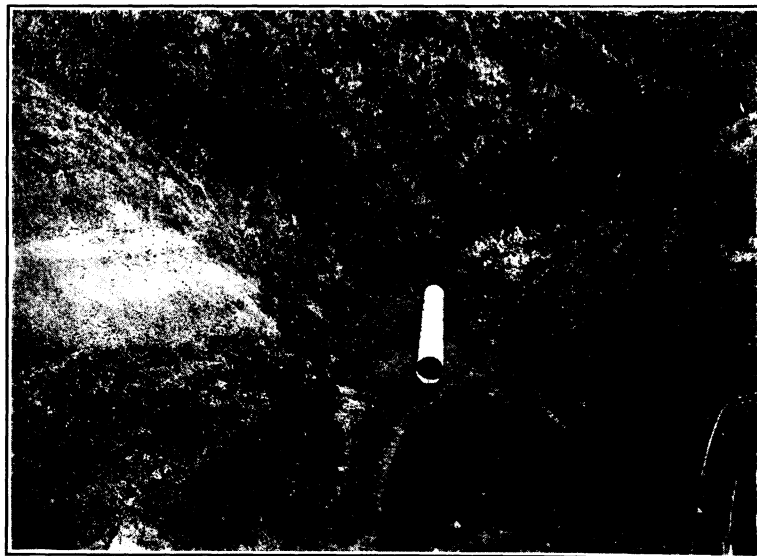
The construction of the Candon diversion, a section of 4 kilometers of road north of the municipality of Candon, has been completed and opened to traffic. This section forms a part of the Manila-North Road.



Laborers on Bangar-Tagudin Diversion Road, subprovince of Amburayan.

Five kilometers of the Bangued-Peñarrubia Road have been completed and the remaining 2 kilometers will be finished by July 15.

A new survey is being made of the proposed Santa Cruz diversion, a section of road 16 kilometers in length. Upon the approval of the plans and profile, the subgrade will be put under construction immediately by contract. This road will have a right of way of 15 meters, with a metaled section 4.27 meters in width.



Forty-eight-inch diameter ingot-iron culvert 70 feet long, on the Tagudin diversion, in place ready for the 16-foot (5-meter) fill, subprovince of Amburayan.

On account of the slow progress which was being made on the construction of the Candon bridge, the district engineer recommended to the provincial board that the work be taken over by the province and completed under the supervision of the above-named officer, which was done. At present the work is progressing very rapidly. The approach spans are now entirely completed, piers and superstructure false work is being placed to sustain the main span. The entire bridge will be completed by August 1, provided the present good weather holds out.

The additional work on the Cabugao and Lapog bridges is completed, and the bridges opened to traffic.

The extra work on the Bical bridge will be completed by July 15.

ILOILO.

Early in May the city of Iloilo was visited with another disastrous fire on Calle Real, extending from Calle Iznart to Calle Arsenal on both sides of the street. This section of Calle Real was macadamized



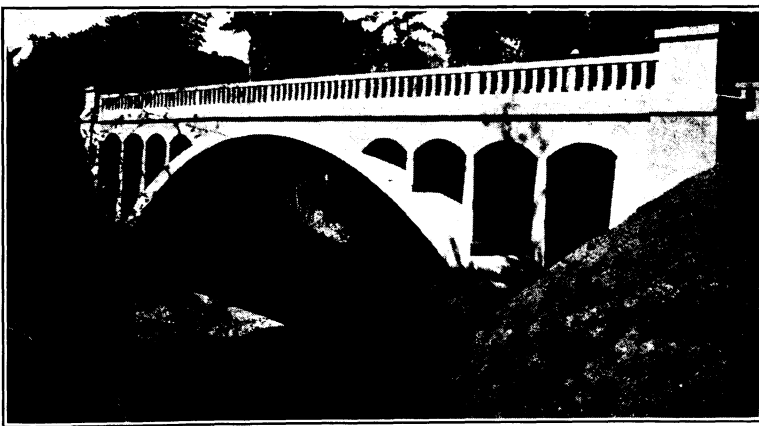
Showing 4 and 6 meter fills over 48-inch galvanized-iron corrugated pipe, subprovince of Amburayan.

in August of 1913. The excellence, both of work and material, was fully demonstrated. In spite of the terrific heat no disintegration or cracking took place. It was noted, however, that an entire section covering 8 or 10 square meters would rise intact for an inch or more, very similar to asphalt. After the fire, this was thoroughly wetted down and rolled. The surfacing is apparently as good as ever, due undoubtedly to the use of the limestone binder. Regular maintenance has been continuous on the city streets under the control of the district engineer and throughout the province.

The Pototan tiendas were completed in April of the current year under contract with J. W. Ford. Excellent results were obtained with the new ribbed roof of ingot iron.

Work has been renewed on the Dueñas-Lambunao Road. Material has been placed and rolled as far as kilometer 7.

An investigation has been started of the water supply on Guimaras Island with a view toward conserving the same as a source of supply for the city of Iloilo. If this proves feasible, a sufficient supply can be obtained at a minimum cost, and the community will not be forced to await the large appropriation necessary for the development of the Tigum River project.



The Abangay Bridge over the Abangay River between Pototan and Dingle, Iloilo Province.

The provincial rock crusher is continuously in operation, a recent contract having been made for the immediate delivery of 10,000 cubic meters of hard limestone for the resurfacing of first-class roads. In addition to this, another contract was entered into for the immediate delivery of 1,000 cubic meters of the hard basalt rock from Nabalas for the continuation of the city street work.

The contract for the construction of culverts on Lucena-Jalaur Road was let to J. W. Ford. Pipes and culverts have been completed as far as kilometer 5.

Work on the parking of provincial grounds continues slowly. Nurseries are well under way, having been provided in May with a large assortment of shrubs and plants obtained from Manila.

Second-class road work has been continuous throughout the quarter. All culverts between Pototan and Dingle have been repaired and about 50 per cent of the entire road regraded. Three kilometers have been resurfaced. About 4 kilometers more of the Iloilo-San Joaquin Road have been opened up and it is hoped to complete the same to Miagao by the end of the year.

The Pototan-Dumangas Road is now in excellent shape as far as kilometer 15. It should be completed in three months if the necessary funds can be provided. A survey has been made for a bridge over the Lub-lub River at kilometer 13. An old Spanish bridge formerly crossed the Lub-lub at this point. The abutments of same are at present used to carry the temporary wooden structure. If it is feasible to encase this old masonry in concrete, a steel span will be recommended, otherwise an arch will be necessary on account of the depth of the opening.

Work on the new Warehouse Street has been completed as far as Calle Progreso. The need of this outlet from the Muelle Loney has already been well demonstrated by the heavy traffic using it.

The construction of the La Paz bridge and streets is again under way. The bridge has been advertised, and the contract, unless the work is undertaken by administration, will have been awarded before this reaches print. Material is coming in very rapidly and the road should be completed in about three months.

Work on the 20-room schoolhouse for the city of Iloilo has at last been started. The delay was due to the difficulty in adjusting the property lines. Tentative plans for the municipal building at Dumangas have been received from the Consulting Architect and submitted to the council for approval. Funds are available, and work will be started as soon as detail plans are received.

Bridge 15.5 on the Oton Road, consisting of two 8-meter slab and girder spans on concrete piles, has been completed. The work on same is excellent and was accomplished by contract awarded to A. Buchanan.

Bids for the construction of bridge 17.3 on the Oton Road have been requested. The plans call for the construction of three 7-meter slab and girder spans on concrete piles.

The contract for the construction of the culverts on the San Miguel-Leon Road has been let to O'Leary & Burns. Grading on the first 2 kilometers from San Miguel has been completed.

Due to the shortage of funds, work on the Iloilo concrete wharf has been stopped. Under special authority, however, all exposed work was completed. The back fill has not yet been placed and until additional money is provided for the construction of same and for the roadway the work cannot be turned over to the public.

Under the appropriation covering the maintenance of the river channel, docks, etc., repairs have been made to all Government docks and wharves in the river. New bents and decking were necessary for the seven docks in the lower reach of the river, serving the bodegas of Warner Barnes & Co., Stevenson & Co., and Germann & Co.

The sum of ₱50,000 allotted for the sea-wall construction has been released and the work started.

A small dock for the quarantine station of the Bureau of Agriculture has been completed.

General repairs have been made to the roof and interior of the high school at Renfrovile.

ISABELA.

The Ilagan Central School is almost completed except for two doors and the painting of partitions and ceiling. The work has been temporarily suspended on account of funds being short.

The substructure of the Rugao bridge is now completed, and the false work is erected ready to receive the steel superstructure. Due to low water in the Cagayan River during the past month, the structural steel has not arrived on the site. However, the water is going up day by day and it is expected that work on the steel will commence very soon. With the completion of this bridge, the only one of its type in the valley, the Province of Isabela has been able to span the worst creek in its territory. It is said that many people and animals have been drowned here and eaten by crocodiles.

On first-class road construction there are now three active projects—the Cordon-San Luis Road, the Echague-Angadanan, and the San Pablo-North Boundary. Construction on the Cordon-San Luis Road started during the latter part of April and is going on well. Of the 9.7 kilometers surveyed there are 2 kilometers ready to receive surfacing. This being a hilly section of the province, the road in most places will have a 6 per cent grade, especially on the approaches to the

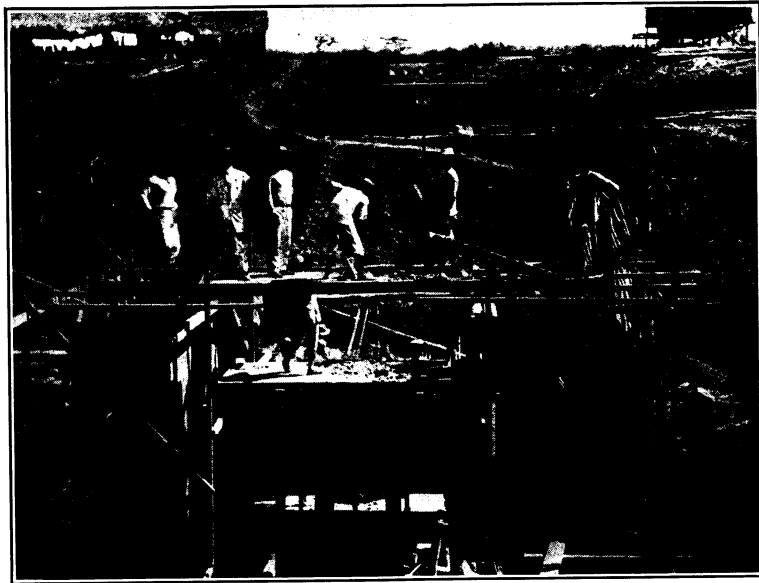
and cart traffic to Isabela as soon as the Cordon-San Luis section is finished.

The section of road between Echague and Angadanan Viejo is now completed as far as it has been surveyed.

The San Pablo-North Boundary Road construction is well under way, but due to lack of tools is progressing slowly. This section is an extension of the Cabagan-San Pablo first-class road toward Tuguegarao. With the amount of funds appropriated it will be possible to complete a little over 1 kilometer. Grading is already completed on 500 meters.

The Constabulary barracks is about 10 per cent completed. Materials are arriving slowly on account of low water in the Cagayan River, and the work has been held back in consequence. A great saving is being made on this work on account of Constabulary soldiers working free. They are detailed for driving bull carts to bring gravel and water from the Pinacanauan River. For carpentry and concrete work there are special men. This being an Insular job, the province does not get its regular surcharge. With the above conditions of free soldiers' work, gravel and sand cost only ₱1.60 per cubic meter, whereas for the other jobs these materials cost ₱3 to ₱3.50 per cubic meter.

General repair work is being done on the second and third class roads. Four wooden bridges with galvanized-iron roofing are under construction between Cauayan and Angadanan and will be finished before the flood period commences. The creeks spanned by these bridges are unfordable during high water, but with their completion



Placing concrete on south pier of Rugao Bridge, showing mixing board, and in the background the north pier and houses of laborers. Isabela Province.



Orange-peel dredging bucket used for excavating under water on the Rugao Bridge, Isabela Province.

creeks. The funds available being insufficient to bring the whole section, 9.7 kilometers, to a first-class condition, gravel is being placed only on high fills and other places where it is badly needed. Gravel costs ₱1.50 per cubic meter, grading an average of ₱0.60 per cubic meter. Some sections are being let to subcontract, costing from 25 centavos to 40 centavos a cubic meter. The scheme used is to give 25 men with their capataz wages for, say, three days for section having, say, 165 cubic meters. The wages of these men for three days would amount to ₱66 on the basis of ₱2 a day for capataz and ₱0.80 for laborers. In this way a cubic meter would cost ₱0.40. The scheme worked better than to contract by the cubic meter. It is used only for cut and fill.

The main feature of the Cordon-San Luis work is the section having a 15 per cent grade. To reduce this to 6 per cent would have necessitated a very heavy cut, and so a loop or semizigzag is being built on the slope with a gradient of 6 per cent. Work has been going slowly for the past month, due to the shortage of tools. This month, however, will be better, for with the new tools just arrived from Manila some 200 to 300 men may be employed, whereas the limit before was 100. The completion of this section will enable through cart traffic between Isabela and Nueva Vizcaya to be established. At the present time, and in spite of the present condition of the road and of the quarantine at San Luis, an average of 15 bull carts and 35 pack animals per day travel from Echague to San Luis, carrying oil, salt, groceries, canned stuffs, etc. On their return they bring rice.

The Nueva Vizcaya section between San Luis and Bayombong is being widened considerably, thus preparing it for a continuous vehicle

bull carts and vehicles can travel between Cauayan and the south boundary all the year around. Work on clearing and repairing the road for cart traffic has been started from Cagayan toward Ilagan. Also all river and creek approaches from the north boundary toward Ilagan are being sloped.

An outlet for the Batagan dead water has been dug for a distance of 300 meters alongside the road and then toward the Cagayan River. The roadbed for 200 meters in this place has been raised to the level of the bridge floor. A double pipe was placed along the other outlet. This work will keep water from the crown of the road, thus making it passable at any time of the year.

It is worthy of mention that the Bureau of Agriculture's inspector, Mr. Manus, has cooperated with this office in establishing mango nurseries by furnishing land, tools, carabaos, and carts free. The place selected for the nurseries is near the agricultural experimental station in a wooded place on the Ilagan-San Antonio Road. About 2,000 seeds have been planted. Nurseries on a small scale have been started at San Pablo, on the high bank of the Pinacanauan River, and also at Carig. These are under the immediate charge of the capataz of camineros.

The presidente of San Pablo, Mr. Salvador Tamaliuan, has contributed 60 men to work for two days on the repairs to the Tumauni-San Pablo Road. This is an expression of gratitude for the benefits which the San Pablo people have derived from public works and deserves special commendation.

Since May there have been an average of 10 provincial prisoners working every day on the roads. They certainly help.

Locusts and saltones have worked considerable damage to the grass on the shoulders and slopes of the roads all over the province. In some instances the road appears to the traveller as only a desolate trail in place of the beautiful green-bordered highway so lately seen.

A survey is being made of the future main road from Ilagan to Cauayan. This road will follow the old road through Naguilian; but on reaching the Upi Estero the road will not follow the old trail, but will be directed to the right at an angle of about 30° to meet the Ilagan-San Antonio-Palanan Road at Malalam. This road is followed into Ilagan. The diversion follows approximately the divide between the Upi and Cagayan Rivers, and is on high ground all the way except from Malalam to the foot of the ascent to Ilagan, 3 kilometers. It is expected that a maximum grade of 6 per cent can be established all along the new stretch.

LAGUNA.

Reconstruction of the Calamba-Beach Road has been completed, adding 2.7 kilometers of road to the first-class system. The money for this work was appropriated by the municipality of Calamba, but the road will be declared a part of the provincial system and maintained as such on account of the importance of Calamba as a lake shipping point.

Work on the San Pablo-Nagcarlan Road has progressed rather slowly on account of lack of labor and cart transportation. More than 4 kilometers have been completed, of which 3.6 kilometers are continuous, beginning at San Pablo. Slightly more than half a kilometer has been constructed out near Nagcarlan where there was a very bad section that needed immediate attention. The part near Nagcarlan has been surfaced with hand-broken river boulders, while Los Baños stone has been used on that near San Pablo. The work already done, together with what it will be possible to do before the heavy rains close down the work, will be sufficient to keep the road between the two towns open, and will prove of incalculable benefit to the people of Nagcarlan.

Repairs of a semipermanent nature have been made on the north end of the road from Nagcarlan to Maimpis, where it joins the Magdalena-Majayjay Road of the present first-class system. This part is open to wheeled traffic at present and will probably be kept open during this rainy season unless it is of extraordinary severity. With a good surfaced road from San Pablo to Maimpis, Magdalena, the section traversed will become the most prosperous part of the Islands, the roadside for the entire distance being lined with magnificent coconut groves in prime bearing condition. The country is picturesque, lying at the feet of Banajao and San Cristobal. It is dotted with circular crater lakes, several of which are very near and visible from the road. The completion of this road will connect up all the first-class roads in the province, and make Santa Cruz, and especially Pagsanjan with its wonderful gorge and falls, easily accessible to Manila by automobile.

Considerable repair work has been done on the Lumban-Mavitac second-class road and it is now in fair condition for wheeled vehicles throughout its entire length of 20 kilometers. A 4.5-meter adobe arch culvert on the San Pablo-Alaminos Road has been repaired and 150 meters of road across a bad mudhole on the San Pablo end repaired and surfaced with Los Baños stone, thus opening up 12 kilometers of second-class road as far as the Magampon River, where it will be necessary to repair an old adobe bridge of considerable size. Beyond this river the road is in fair second-class condition as far as Alaminos, and it is planned to make such repairs to the old bridge as will open it to traffic, and thus connect the municipality of Alaminos with the provincial road system. No change is noted in the Calamba-Vigaa Road save that the temporary bridge over the railroad has been repaired by the railroad company and is no longer dangerous. Owing to the increased motor travel between Batangas and Manila and the growing importance of Calamba as a fruit, vegetable, and fish market, the reconstruction and resurfacing of this road is becoming imperative, and it is hoped that funds may be available for the work another year.

Two bridge projects are under consideration at present, one at Pagsanjan across the Balanac River to connect the town with the market and railroad station, and the other near Calamba on the Manila-South Road across the San Cristobal River to replace an old Spanish latticed truss that was washed out two years ago. The Pagsanjan bridge will consist of one 192-foot span, taken from the old Calumpit bridge and donated by the Manila Railroad Company, and two 8-meter I-beam approach spans. Funds for its erection include an Insular allotment of ₱18,000, a donation by the Manila Railroad Company of ₱10,000 (this in addition to 192-foot steel truss), and such provincial and municipal funds as may be necessary. The San Cristobal bridge is to be a 25-meter reinforced-concrete arch, open spandrel type, similar to the Vaughn bridge across the San Juan River less than 1 kilometer away. It is estimated that it will cost ₱30,000, and the province has asked for a loan to provide for its construction. It is very necessary that this bridge be built within the year, for the temporary Oregon pine truss bridge, built immediately

after the loss of the old bridge, is beginning to decay and will very probably be unsafe after another year's use.

The high school at Santa Cruz is nearing completion, and one wing of it will be ready for occupancy by July 15. The following changes were authorized and have been incorporated in the building: All partitions of concrete instead of wood; office and storeroom placed in right-hand corner room; partition between the assembly hall and the two adjacent rooms left out and the two rooms made a part of the hall; and several minor changes affecting location of doors, character and size of blackboards, etc. These changes have served to increase the cost of the building, so that, while it can be completed well within the estimate, the money appropriated will not be sufficient. Arrangements are being made to secure additional funds in order that the building may be entirely completed while the work is under way.

Work on the Rizal Memorial School is not so far advanced as that on the high school, but is progressing at a satisfactory rate, and the placing of the roof will soon be started. The same changes noted in the case of the high school are also incorporated in this school, save that in this building the columns that were in the partitions between the assembly hall and the adjacent rooms are left out, owing to the changes having been made in time to permit of so doing. The enlarged hall in this building will in consequence be free from obstructions, and therefore superior to that of the high school.

Progress on the San Pablo market and tiendas has been somewhat retarded by lack of materials and labor, but at present the work is progressing rapidly and will be completed on time, easily within the estimate. The roof of the market is nearly completed and about one-half of the floor is in place, while the construction of the tiendas is almost far enough advanced for the roof framing to be placed. All the tiendas under construction are already leased and the municipal authorities are planning to have another group erected as soon as those under construction are completed.

The grading of the Nagcarlan market site has been completed, and there is a balance of ₱5,734.38 available for the construction of tiendas, or possibly, with the addition of other funds, of another market building. The increase in the market collections since the completion of the present building have been marvellous, and it is probable that another building will be erected.

The construction of the physical laboratory at the College of Agriculture, for which ₱30,000 is available, has progressed rapidly, and the roofing trusses will be erected within the next week.

New building projects authorized are the construction of a No. 7 Bureau of Education schoolhouse at Lilio with ₱14,000 available for same; completion of the Calauan schoolhouse with ₱1,000 available for the work; alteration and repair of Biñan schoolhouse (old friar hacienda building) for which ₱5,000 is available; and the construction of a temporary building for domestic-science use at San Pablo on the grounds of the intermediate school, for the construction of which whatever funds are necessary are available.

Bids for the construction of the Malvar waterworks at San Pablo were opened at the Bureau of Public Works on June 12 and it was found that the Atlantic, Gulf and Pacific Company's bid of ₱57,021.28 was lowest on materials and that of Milton E. Springer Company, ₱24,492, was lowest on the installation, although neither was as low as the estimated cost. It is probable that the Atlantic, Gulf and Pacific Company will be awarded the contract for the material since their bid for same is but very little higher than its estimated cost, and that the work of installation will be done by administration.

The output of the Los Baños quarry for the quarter ended March 31, was 6,172.50 cubic meters which, sold at ₱2.20 per cubic meter, produced an income of ₱13,570.50. It is estimated that the output for the quarter ending June 30 will be 7,451.80 cubic meters, producing an income of ₱16,393.96. The car supply for the past six months has been much better than the average, and this, with a good demand for stone, has permitted of practically continuous and, therefore, economical operation. Taking advantage of the profits thus made, a set of 30 by 14 inch rolls have been purchased and will shortly be installed for the purpose of crushing ½-inch size stone for maintenance work. At the time the rolls are installed the crusher plant will be moved nearer the quarry and rearranged so as to provide for the handling of the stone either by gravity or power, thus eliminating considerable labor. Investigations of a possible water-power plant to operate the crushers are being made, and the crusher plant will be planned so that such power can be used should it prove available.

LA UNION.

Surveys have been completed and plans submitted to the Executive Bureau for the construction of a modern reinforced-concrete market building at Bauang.

An Insular loan of ₱9,000 has been made available for the renovation of the old Spanish presidencia at Luna. The present structure is in a very dilapidated condition and is a menace to those who

occupy the building. The municipality has on hand approximately ₱3,000 worth of squared ipil logs, well seasoned, which can be used to great advantage in making the necessary repairs.

About May 15 all grading was completed on the Balaoan-Bangar section of the Bacnotan-North Boundary Road, and on the Balaoan-Luna branch also. The last 2 kilometers of the Balaoan-Luna Road were built under the "paquiao" system, the foreman in charge dealing directly with the laborers in small groups. They contracted small sections at a price per lineal meter which averaged 10½ centavos per cubic meter of earth in place, not compacted. Heretofore in this province laborers have experienced considerable difficulty in securing their wages from grading contractors for whom they had worked, and at first were a little shy about entering into any agreement with the Government for doing work by "paquiao;" but before the grading was completed it was found very easy to secure all the labor necessary to do the work.

Ground has been broken and construction commenced on a modern reinforced-concrete market, Type A, 24 by 42.8 meters, at San Fernando. Work on this project has been delayed two or three months on account of the difficulty in securing a concrete foreman competent to do the work. Gravel for the concrete on this project is hauled 11 kilometers from the Bauang River, at a unit cost of ₱4.50. Gravel for the fill beneath the floor can be obtained from a hill east of San Fernando, 1 kilometer distant, at a unit cost of ₱1.20. Sand will be brought from San Juan, 7 kilometers north, at a cost of ₱3 per cubic meter.

Funds amounting to ₱31,260 have been appropriated for a 16-room reinforced-concrete school building at San Fernando, Bureau of Education standard plan No. 20 (modified). Contractors' bids for this job were to have been opened June 15, but as the funds available were not sufficient to complete the building, it is very probable that the work will have to be started by administration and carried on as far as funds on hand will permit.

LEYTE.

The work on the Palo-South Road is progressing satisfactorily. Between March 15 and July 1, 5 kilometers were entirely completed and the grading was finished to Dulag. The work has been considerably hampered by unseasonable rains and by the necessity of relaying the tramway from the road to a new gravel deposit nearer Dulag, after the work had progressed to such a distance that the tramway would no longer reach to the former deposit. Crusher operations have been discontinued and a gravel road is being built by the following method: The screening is done in one operation by the use of two screens, of 2½-inch and ¾-inch mesh, respectively, set in a single frame. The first course is laid with the gravel rejected by the 2½-inch screen, the pebbles varying from 4 to 1½-inches in diameter. A small quantity of screenings is added, and the course rolled without the use of water. The second course is built of the gravel that falls between the screens, the pebbles of which vary from 1½-inches to ¾-inch in diameter. The screenings that pass both screens, consisting of sand and a few pebbles up to ½-inch in diameter, are used as a binder.

The "paquiao" system was finally inaugurated on the Palo-South Road with very successful results, but only after persistent effort on the part of the assistant engineers in charge. The men were at first distrustful, but finally became so interested that it was difficult to keep laborers on other projects. The "paquiao" men were doing so much better than the others that it became necessary to turn some men away from the road construction work in order to keep the other projects going. The following table shows a few results of the system. It will be noted that while the work was done at a saving to the Government of nearly 50 per cent, the laborers increased their earnings from 70 to 100 per cent.

	Kilometer 54.		Paquiao.	
	Force %.	Paquiao.	Kilometer 55.	Kilometer 57.
Lineal meters of road built.....	340	660	1,000	780
Cubic meters of earth moved.....	800	1,352	1,875	2,151
Unit price of grading.....	₱0.76	₱0.40	₱0.40	₱0.40
Cost of grading.....	₱608.00	₱540.80	₱750.00	₱860.40
Cost of clearing.....		₱6.75	₱25.00	₱24.60
Cost of supervision.....		₱61.00	₱70.00	₱104.00
Total cost.....	₱608.00	₱608.55	₱845.00	₱989.00
Unit cost of grading.....	₱0.76	₱0.45	₱0.45	₱0.46
Laborers employed on grading.....	130	70	80	75
Days worked.....	9	8	9	13
Average daily wage on grading.....	₱0.52	₱0.97	₱1.04	₱0.88

A few other unit costs noted on this project may be of interest. Gravel was screened, loaded into cars, and the cars pushed out of pit for ₱0.85 per cubic meter by paquiao. Average cost of hauling by dinky locomotive, ₱0.084 per kilometer-meter, but varies from ₱0.06

to ₱0.10 per kilometer-meter, depending on whether or not labor is available to load cars enough to run locomotive to capacity. Moving and relaying tramway cost ₱210 per kilometer, since considerable care must be taken in laying to prevent the derailment of cars and engine. During the first quincena of June, 1914, 705 cubic meters of gravel were moved 5 kilometers in twenty-two engine days, working a day and night shift. The locomotive has proved itself far superior to the carabao cart, since it reduces the cost of hauling slightly and is always available. Moreover, owing to the constant rains, the subgrade and surrounding country are always wet, thus allowing only a few days at a time during which the carabao can work to advantage.

The Burauen school (standard revised plan No. 7) has been completed by administration in one hundred working days at a cost of approximately ₱15,900. The estimate was ₱15,372, and contemplated the use of Apollo roofing. Three Crown roofing was used which accounts for the increased cost. The labor and supervision on this building amounted to ₱3,277.60, which would have insured a total cost below the average on a building constructed in a more accessible locality. Transportation cost, ₱1,888.39.

The Babatngon school, standard plan No. 3 (revised), has been completed by administration at a cost of ₱5,900 in round numbers. The framing timbers were furnished free by the municipality.

The construction of the Guinarona school, standard plan No. 2 (revised), was recently commenced by administration. At the present rate of progress it will be entirely completed in thirty working days within the estimate of ₱5,300.

The following contra costa bridges have been completed:

Bridge.	Actual cost.	Estimated cost.
Pandan.....	₱7,700.00	₱9,500.00
Panaliwadan.....	6,480.00	8,100.00
Hindang.....	7,700.00	9,900.00

The costs include the approaches and metaling over the structures, while the estimates do not.

From the saving made on these and the other contra costa bridges it was possible to appropriate ₱7,200 for the construction of Taganas bridge, for which material has been requisitioned. The piles have already been poured and work will be begun by administration as soon as the remainder of the materials arrives, and the gang and equipment now finishing Pamipian and Binabulan bridges, which are in same vicinity as Taganas, can be transferred to the latter bridge.

Material has also been requisitioned and work will shortly begin on the Guinarona bridge, kilometer 37.6, Palo-South Road. This is a standard 12-meter girder bridge on wooden piles.

Work has just been commenced on a provincial bodega in Tacloban. This is a wooden frame structure, supported on concrete piers, and sheathed and roofed with galvanized iron. It is to be 10.15 by 20.5 meters. Estimated cost, ₱2,600. Work is being done by administration.

The Baybay market (43.5 by 21 meters) is nearly completed.

The lowest bid received for the Palo market (43.5 by 21 meters) was ₱15,447.60, tendered by Mr. B. Hagans, of Cebu. As this bid is ₱1,184 in excess of the district engineer's estimate figured on same basis as contractor's bid, the Palo council voted to have the work done by administration. Material has been requisitioned and work will begin shortly.

Work has been commenced on the dam and diversion ditch at Guinawan near kilometer 26.5, Palo-South Road. This section is flooded several times a year by the overflow from the Binahaan River, which is also gradually encroaching upon the road. The pile driver, hoisting engine, etc., at work on the west coast, a hand pile driver with a 1,000-pound hammer, will be used for driving the piles for the dam. The excavation is being done by "paquiao" at a cost of 40 centavos per cubic meter.

The heavy rains of June 18 caused floods which carried away the temporary wooden bridges at Mainit and Tunga on the Tacloban-Carigara Road.

MANILA.

The Bureau of Public Works' appropriation bill No. 2319 made available the following amounts:

Maintenance, alteration, and repair of public buildings.....	₱130,000.00
Maintenance of Manila Harbor and lower Pasig.....	175,000.00
Maintenance of Manila esteros.....	50,000.00
Maintenance of miscellaneous harbors not specifically set forth.....	5,000.00
Maintenance of Pasig River from the Bridge of Spain to Laguna de Bay.....	10,000.00
Maintenance and repair of lighthouses.....	60,000.00
Total.....	430,000.00

Various alterations and improvements made on Insular buildings in Manila and paid for by their current appropriations, also Insular buildings under contract, bring the total amount available for work under the supervision of the structural engineer's office to the sum of ₱1,211,229.16 for the fiscal year 1914. Approximately 90 per cent of the work represented by this sum will be completed before December 31, and ₱581,555.58 has been expended or obligated as of June 1.

The principal items comprised in the above totals consist of repairs to buildings occupied by Insular bureaus, rewiring of the General Hospital, Bureau of Internal Revenue, the Bureau of Health and the Intendencia, the dredging of Manila Harbor, the esteros, and the upper Pasig, together with the contract work for the Girls' Dormitory and the addition to the dispensary.

The repairs to Cape Melville light on Balabac Island were finished in the latter part of May, 1914, at an approximate cost of ₱6,000, and the foreman engaged upon this work will proceed immediately with repairs to the Managuin light station.

The construction of the Balabac light station, consisting of concrete keeper's dwelling, concrete kitchen, 20-foot concrete beacon, and a 3,000-gallon cistern is proceeding satisfactorily, and will be completed by the end of September.

Various repairs have been carried out on the following light stations: Corregidor, in Manila Harbor; Cabra light station, on Cabra Island; Subic Bay light station, at the entrance of Subic Bay; Hermano Mayor, on Hermano Mayor Island; Escareo light station, on the island of Mindoro; San Jacinto light station, on Ticao Island; Tanao Island light, off the coast of Ambos Camarines; Cape Melville, on Balabac Island; and Balabac light station, also on Balabac Island.

The reconstruction of the Hermano Mayor light station on Hermano Mayor Island, consisting of concrete dwelling, concrete kitchen, and steel tower, together with a 3,000-gallon cistern, was completed in the latter part of March at an approximate cost of ₱10,000.

A crew of men is at present erecting a concrete acetylene beacon at Tanao Island in conjunction with the reconstruction of the Ocata light station, which latter consists of a 20-foot concrete acetylene beacon and concrete kitchen. It is proposed to request funds to construct a concrete dwelling next fiscal year.

The contractor for the fill on the university campus having failed to comply with the terms of his contract, the work was taken over and is being completed by administration.

The work on the girls' dormitory is proceeding rapidly and satisfactorily, and there is little doubt that the work will be completed before the contract time expires at the end of November.

Dredging work in Manila has proceeded exceptionally well. Six dredges are at present engaged, and from January 1 to June 1 have excavated over 285,000 cubic meters of material from the esteros, Pasig River, and Manila Harbor.

Work on the repainting of piers 3 and 5 was commenced on March 12 and completed June 18. On pier 3, 15,408 square meters of surface was thoroughly scraped and painted one coat at a total cost of ₱4,383.03, or approximately ₱0.284 per square meter. On pier 5, 19,575.5 square meters of surface were similarly treated at a total cost of ₱5,003.51, or approximately ₱0.256 per square meter. About 49 per cent of the total surface painted was galvanized iron on sides and roof, the remainder being structural steel under the pier floors. The galvanized iron was painted with Pabco S. S. Red, the structural steel with gas tar, applied hot and filled with clean dry sand. The cost of scraping and chipping was about half the total cost of the work. The workmen suffered a good deal from inflamed eyes during the chipping process. The old paint was a graphite compound.

MISAMIS.

The construction of the Agoho barrio school, project No. 24, has been completed at a cost of ₱5,600. This is a standard 2-room building, plan No. 2. Actual work started March 15, all material being on the site. Sand and gravel were donated by the people living in the barrio of Agoho. The woodwork throughout the building was given three coats of paint, allowing seven days for each coat to dry before following with the next. An American overseer was in charge of this work, along with two other projects. The cost of superintendency was thus kept below normal.

The road from Mambajao to Agoho, a distance of 6 kilometers, has been graded, a light course of gravel placed, and the job thoroughly rolled. This is now a very good second-class road. The hill, 1 kilometer from Mambajao, was reduced from an 8 per cent to a 4 per cent grade by blasting off the top and filling in the bottom, where there is a reverse grade.

Kilometers 10 and 11 on the Mambajao-Mahinog Road have been graded and surfaced, which now makes 10 kilometers of this road in very good second-class condition. There are remaining only 4 kilometers to grade and surface in order to complete the road to Mahinog.

When this work is completed it will give the two automobiles at Mambajao the use of 21 kilometers of second-class road.

A nursery has been started and seeds of the following varieties have been planted: Tamarind, acacia, camanchili, dungon, pajao, magtalisay, ipil, pugahan, caballero (yellow), caballero (red), and caya-caya. The district engineer has requested the provincial governor to assist in securing seeds from the different municipalities through the presidentes, and the above-mentioned varieties have been received, many more being expected daily. Some of the trees may not be suitable for shade trees, but the characteristics of each variety will be looked into, and a more complete report may be expected from this district as the nursery becomes further developed. A record is being kept of the planting and germination of all seeds. Some of the trees are now 5 inches tall, the seeds having been planted May 21. The tamarinds, acacias, and camanchilis all seem to grow very rapidly.

NUEVA ECIJA.

The collapsible bridges at Cabanatuan and Gapan were floated off the first time during the recent baguio of June 17 and 18. No damage was done to the bridge at Gapan, but owing to the enormous amount of drift which lodged on the piles of the Cabanatuan bridge, two bents of piles were washed out. The bed of the river is here composed of sand and gravel, and was washed out to a depth of 9 meters in the center of the river where the current was strongest. The two bents of piles which were washed out will be replaced by framed bents which will be anchored to the main cable.

All temporary crossings on the road between San José and Lupao were washed away during the recent baguio, but as this road is only a third-class road with but little traffic during the rainy season, no effort will be made to replace this crossing until the rains are over.

A new right of way has been obtained for the road between Cabanatuan and Santa Rosa, and grading will be started as soon as the rainy season is over. This section, when completed, will shorten the distance from Cabanatuan to Santa Rosa by 2.5 kilometers. The old road follows the river.

The steel bridge over the Baliuag River has been completed. The Atlantic, Gulf and Pacific Company of Manila were the contractors.

Four kilometers of subgrade have been completed on the Cabanatuan-Aliaga Road, but since all the road between Cabanatuan and Aliaga is in the overflow section of the Rio Grande, no gravel will be placed until after the rainy season.

An artesian well has just been completed in the town of Aliaga and the well rig which was in Aliaga is moving to Cabanatuan, where another deep well is to be driven. The deep-well rig which has been working in Pangasinan Province has been moved to Cuyapo and is now driving a deep well there.

Plans are being prepared for markets in Cabanatuan and Cuyapo and work will be started as soon as plans are completed.

Funds were received during the past three months for the completion of the Jaen school building. The work will be completed by July 10.

The sum of ₱6,360 has been appropriated for the construction of a standard No. 2 school building in the barrio of Payapa, municipality of Peñaranda. This building has been advertised, bids to be opened on July 1.

The sum of ₱14,994.80 has been appropriated for the construction of an academic building at the Central Luzon Agricultural School, and work on this building will be started as soon as materials are received.

Three kilometers of subgrade and 2 kilometers of surfacing have been completed on the Gapan-Pampanga Boundary Road, and funds have been appropriated for the completion of the road as far as Cabiao.

Grading to the amount of 67,740 cubic meters has been completed on the Guimba-Pangasinan section of the Manila-North Road, at an average cost of 43 centavos per cubic meter. This cost includes clearing the right of way, putting in temporary crossings, and building construction camps.

The province has recently rented a locomotive, 40 cars, and 3 kilometers of track from the Bureau of Public Works for delivering gravel on the Guimba-Pangasinan section, but the equipment cannot be used until the end of the rainy season, owing to difficulties in getting proper supplies for setting up the cars. It is expected, however, to have all equipment in place and ready to start hauling by the end of the rainy season.

The province has just finished a month's experiment with one of the steam wagons of the Bureau of Public Works, and finds too much trouble in turning for the wagon to be of value in this province.

Construction has been greatly interfered with during the past two months by the early rainy season and the locusts.

OCCIDENTAL NEGROS.

Work will soon be started on the Maragandang bridge on the Bago-Maao Road. This road when completed will connect up Maao with the through north and south coastal road. Fourteen kilometers of first-class road, practically up to the Maragandang River, are now built and it is expected that by the time the bridge is completed funds will be available for the continuation of the road into Maao, a distance of 5.4 kilometers. A large tract of very fertile land will thus be opened up.

Surveys have been made and plans are now under way for a bridge across the Binalbagan River on the Hinigaran-Isabela Road. The surfacing of this road up to the river, 14 kilometers from Hinigaran, will be completed this season. Grading work beyond the river into Isabela, a distance of 5 kilometers, is now being done, 2 kilometers having already been finished. This work when completed will give Isabela a first-class road connecting with the through north and south road.

Ten kilometers of subgrade of standard section on the La Carlota-La Castellana Road have been completed and the first-class metaling work on this section is well under way. Three reinforced-concrete culverts are now constructed.

The subgrade on the La Carlota-La Granja Road has been completed to the Najalin River, a distance of 6.6 kilometers from La Carlota, and the metaling is now being placed. The ford has been put in good condition. This is to be a second-class road of standard section, and will make the agricultural experimental station at La Granja accessible all the year to the hacenderos throughout the province. It will also provide a better outlet for the products of eight haciendas situated back of La Granja. It can reasonably be expected that the amount of traffic which will come to this road will make it advisable in the near future to convert it into a first-class road.

The subgrade on the Alicante-Victorias Road has been completed, and 1 kilometer of surfacing finished. This road is a 5.3-kilometer extension of the first-class Bacolod-North Road. Funds are available for the completion of the surfacing into Victorias and the work is being pushed as rapidly as possible. Six reinforced-concrete culverts are now under construction by administration. An Insular loan of ₱60,000 has recently been obtained for constructing three reinforced-concrete bridges and one timber collapsible-deck bridge on this road. Plans for these are now being made and construction will begin very shortly.

The grading on the Binalbagan-Himamaylan Road has been completed to the Diet River, municipality of Himamaylan, 14.8 kilometers south of Binalbagan. The funds available will permit the surfacing of only 2 kilometers, but as the soil for the rest of the way is of a fairly good sandy-clay composition and has been well tamped, neither inconvenience to the public nor damage to the road is expected by reason of letting it go through the coming rainy season under traffic. The two rivers on this section have ferries operated under contract with the province.

The sum of ₱6,000 has been recently appropriated for ditching, crowning, and metaling 2 of the remaining 8 kilometers of third-class road on the Bacolod-South Road between Valladolid and San Enrique.

Ten kilometers of road between Bacolod and Silay and 4 between Saravia and Alicante will be resurfaced this season.

The Province of Occidental Negros was awarded the ₱5,000 prize for 1913 for transferring the greatest percentage of its road and bridge funds to its general funds, and it has been decided to use this money in the construction of an 11-meter reinforced-concrete girder bridge on the Tabigue River, Bacolod-North Road, replacing the last of the old timber bridges on this road. This bridge will be known as the "Prize Bridge."

The contract for constructing the domestic-science school building at Bacolod was let to W. H. Lambert & Co., of Iloilo, the contract price for the building complete, including plumbing fixtures and septic vault, being ₱8,515, and the time one hundred and twenty calendar days. The building is to be a single-story reinforced-concrete structure, 11.20 by 17.50 meters, and built in accordance with standard plans prepared by the Bureau of Education. Work was begun May 5 and should be completed, at the present rate of progress, by July 20.

W. H. Lambert & Co. were also the successful bidders for constructing a 2-story reinforced-concrete vault, size 4.60 by 5.50 meters, for the provincial building at Bacolod. Their bid was ₱2,636.40, the province furnishing the vault doors. Materials have been delivered for this work and the actual construction will begin shortly.

Construction of the Binalbagan school, Bureau of Education plan No. 5 (special), was held up for a couple of months due to delay in receiving a shipment of cement. Work was resumed June 5 and is progressing satisfactorily.

Bids received for the Murcia central school, plan No. 3, were rejected as being too high, and the work will be carried out by administration. Materials are now being delivered.

After much delay the question of a site for the Hinigaran market building, size 18 by 38 meters, has been satisfactorily settled and the property acquired. An appropriation of ₱15,000 has been available for some time. This work will be advertised immediately.

The question of sites for market buildings at San Carlos, Silay, Bacolod, Bago, and Saravia is still unsettled, the main trouble being the inability of the municipalities to purchase suitable sites at anything like reasonable prices. Expropriation proceedings have been recommended for all such cases.

The sum of ₱30,000 was appropriated by the last session of the Legislature for constructing piers at Silay, Bacolod, and Pulupandan. As this sum is entirely inadequate for the purpose, investigations are being made preliminary to making recommendations regarding these projects.

There are two well-boring outfits operating in the province, one at San Carlos and the other on the west coast. The latter has finished seven wells in Bacolod and near-by barrios within the last nine weeks.

Up to the middle of June the sum total of appropriations for the current year for roads, bridges, and buildings under the supervision of the district engineer amounted to ₱456,000. This does not include the ₱30,000 for pier construction, which has not yet been released.

ORIENTAL NEGROS.

The construction of the Tanjay-Bais Road as first class was commenced in April. Progress to date has been very slow on account of scarcity of labor, as the hacenderos are still grinding cane. About 1½ kilometers of road have been graded and about 100 cubic meters of rock delivered on the side of the road and broken. The use of a tramway has been donated to the province by hacenderos interested in the road, and 2 kilometers of track have been laid from a gravel pit in the Bais River.

The Dumaguete market building, 24 by 42.8 meters, was finished about June 25, well within the contract time.

Work on the Bais market has been held up for the past two months on account of the inability of the contractor to secure lumber. All materials are now on the ground and the contractor expects to complete the building within another six weeks.

The Tayabas school, Bureau of Education plan No. 3, has been completed with the exception of placing the floor, ceiling, and partitions, and painting the woodwork.

About 50 per cent of the concrete for a 7-room school at Guijulan is in place. Work was started on this building in April, but is progressing slowly, owing to difficulty in obtaining labor and transportation.

The work of raising and riprapping the subgrade of the Amblan-Tanjay Road has been completed to kilometer 26, leaving about 4 kilometers yet to be done. More than half of the 12 kilometers of road between these two towns lies in salt-water swamps and is badly washed by the tide. All subgrade is being built up to not less than 50 centimeters above high tide and the slopes riprapped with coral limestone.

The pipe for the construction of the Talingting waterworks has just been received and transported to the site. Talingting is the largest barrio on Siquijor Island, is located on the east coast, and contains some 2,000 people. The present water supply is very poor in quality and small in quantity. The proposed system will take water from a spring in the hills about 4 kilometers distant from the barrio and will consist of 4½ kilometers of 2-inch and 1-inch pipe, a tank for storing the night flow, and three hydrants. It is estimated that a flow of 10 gallons per minute can be secured. On the completion of this system, practically all the inhabitants of Siquijor Island will be supplied with good drinking water, due largely to the efforts of former Lieutenant-Governor Fugate. For the purchase of pipe an allotment of ₱3,575 was secured from the Bureau of Public Works. The balance of funds necessary have been raised locally by means of contributions from individuals and from the municipality of Larena. All transportation of materials has been donated and it is expected that all work of laying the pipe will be accomplished by voluntary labor.

PAMPANGA.

The San Fernando-Arayat section of the Pampanga-Nueva Ecija Road lacks only 300 meters of being complete. It will be passable, however, during the rainy season. The road formerly followed the numerous curves of the San Lorenzo River, but these were eliminated by making two cut-offs about 2 kilometers in length, and a total distance of 452 meters was saved. These cut-offs made it possible

to obtain full right of way through the greater portion of Mexico and to obtain better drainage than the old right of way provided. The new location will necessitate, however, the construction of a 10-meter bridge in the municipality of Mexico. The public-spirited citizens, headed by Doctor Lacsamana, have subscribed a fund to assist in purchasing the right of way.

The provincial board has appropriated the sum of ₱6,000 for the construction of a railroad siding to the provincial quarry. The province will do all the grading and purchase the necessary right of way. The siding is about 1,000 meters in length. This will bring about the cheapest possible method of transportation, since all municipalities in the province except two are located either on river banks or on the railroad.

The Bacolor and Guagua school buildings, both Bureau of Education plan No. 10, will be ready at the beginning of the school year. The former is 40 centimeters higher than the original plan, and the two back rooms and the assembly hall open on porches constructed back of the hall and along the wings. The partitions are of concrete. The Guagua school was partly built last year, but owing to lack of funds the partitions and ceilings were omitted.

Two new concrete 5-meter culverts are being built on the Apalit-Macabebe Road, and a double reinforced-concrete 4.5 by 2 meters culvert will soon be finished on the Bacolor-Santa Rita Road.

The Santa Ana bridge, 15-meter span by 5-meter clearance, is under reconstruction. The old adobe abutments have been faced with concrete and two new piers built to support the wooden floor. If results obtained from tests prove satisfactory, the floor will be replaced with a light concrete one.

Six hundred acacias are being transplanted from the San Fernando nursery along the provincial roads. Fruit trees are also used when obtainable. Each maintenance capataz has been directed to establish a nursery for his roads.

The present provincial board of Pampanga is one of the most progressive in the history of the province. Realizing that the former attitude and policy did not produce satisfactory results, the board has passed a resolution embodying the following principles:

- (1) First-class roads only are to be constructed.
- (2) No new road is to be begun until the one started has been completed.
- (3) All new roads are to start from or be the continuation of first-class roads already in existence.

The order in which the roads are to be built is also given. The traffic arteries are to be built first, then the feeders.

PANGASINAN.

It is expected that the subgrade on the Rosales-Nueva Ecija boundary line section of the Manila-North Road will be completed on July 1. Surfacing has been very seriously delayed by the recent baguios.

The Pangasinan-Tarlac Boundary Road between Bayambang and Camiling has been well graded throughout. On the completion of the Bayambang bridge this will permit through traffic from Camiling to Baguio.

The Lingayen market building, a 21 by 48.5 meter type "B" market, has just been completed at a contract price of ₱16,950, inclusive of fill, surcharges, etc. To date this market has cost ₱21,910.54. It is expected to expend the balance of ₱977.11 for extra fill, a fence, and water connections.

The Dagupan market, a 30 by 40 meter San Roque type building with tile roof, was completed by the same company on May 13, 1914. The contract price was ₱22,400. An additional amount of ₱197.75 was expended in the purchase of the site and grading of the same. The present balance of ₱7,846.19 is intended to be expended in construction of a fence, water connections, and market stalls.

The flood season began promptly on June 1. The Agno River rose rapidly and the water has lowered only 1 foot up to date. The collapsible bridges at Carmen and Tayug both suffered considerable damage.

Bids were opened recently for market buildings in San Fabian and Mangaldan. It is expected that bids will be called for during the month of August on market buildings for Rosales and Tayug.

The surfacing of the San Isidro Labrador to Alaminos Road has been completed. This road was formerly impassable during the rainy season. It is now in excellent second-class condition.

RIZAL.

A landing dock has been completed at the Talim Island powder magazine, a structure recently built for the Insular Purchasing Agent. The dock cost approximately ₱600, making the total cost of the

project to date ₱28,550.06. A second dock on the opposite side of the island is to be built with the balance of the appropriated funds.

A provincial storehouse is under contract to be built in Pasig on the recently filled ground lying between the Antipolo Road and the Mariquina River. The building is to be of galvanized iron with concrete posts and gravel floor, 33 by 6 meters. The contract has been awarded to Gregorio Silva, a local contractor, for ₱2,580.

The reconstruction of the Mariquina central school is progressing satisfactorily. The lower floor is practically completed and will be occupied early in July. The whole structure should be finished by the last of July.

Six midden sheds have been constructed in Antipolo for public use. These are of light materials, and were pushed to completion for use in the annual pilgrimage to the shrine of the Virgin of Antipolo.

Two kilometers of 4-meter streets in the municipality of Pasay have been surfaced with Los Baños quarry rock and screenings at a cost of approximately ₱4,500. The surfacing is fairly light, since the traffic is not heavy, and because it was the especial desire of the municipality that as much be done for the money as possible. The same amount had been spent on the road the previous year under the direction of the municipal authorities, but without lasting results. In other words, a first-class macadam road has been built this year for the same amount that had been expended the year before on repairs to a dirt road.

An estimate has been prepared, at the request of the provincial governor, for the construction of a first-class road between Angono and Binangonan. At present a third-class road, 8.3 kilometers long, traversing rice fields, connects these towns. The proposed construction contemplates the erection of two bridges and will cost ₱60,000. The Rizal Cement Company is erecting a plant at Binangonan, and proposes to donate either money or cement to aid in the construction of this road.

Bids were recently received by the Director of Public Works for the erection of a standard 24 by 42.8 meter concrete market in the municipality of Pasay. The bids are now being considered by the municipal council. The site has been secured by expropriation and will cost ₱8,000. A loan of ₱25,000 has been secured from the Insular Government with which to erect the building.

Half a kilometer of road is to be diverted in the municipality of Mariquina, where the river has been cutting in on the Manila-Montalban Road. Money has been appropriated, and materials are on hand to begin construction as soon as right of way matters can be adjusted.

By special request of the provincial board, investigations and surveys have been carried on in connection with boundary disputes between the municipalities in San Mateo and Montalban and the municipalities of Cardona and Binangonan.

Plans for the provincial high school are still in the hands of the Consulting Architect and the Bureau of Education. It is desired to make this high school a show place for provincial visitors to Manila and some trouble has been experienced to bring the estimates within the available appropriation. However, the site has been secured by expropriation proceeding and an early advertising of the plans is expected.

SAMAR.

The seven reinforced-concrete Calbayog bridges are well under way. The one over the Calbayog River, a 35-meter structure of 5 spans, has in place all six of the reinforced-concrete pile bents, and three of the pile caps. The next to be taken up will be the 28-meter bridge over the Minlawaan River, to which place the pile driver has recently been sent. Concrete piles have been cast at two other bridge sites, and a large quantity of materials has been distributed to all of the bridge sites.

Water transportation is practically the only kind available in the province, hence the prevailing monsoon dictates pretty freely where work may be carried on and where not. Good harbors are scarce, and a few waves make it impossible to unload at the majority of the ports. During the northeast monsoon it is possible to deliver materials on the west coast of the islands, and while the southwest monsoon is blowing the east and north coasts may be served. The monsoon changes regularly in May and November, hence, roughly, the first half of the calendar year constitutes the working season for west coast projects and the last half for the east and north coasts.

Gravel for road and bridge work on the west coast can be obtained only from the small islands that skirt the coast. Delivery is by baroto or banca, and generally stops with the changing of the monsoon. However, nearly all the gravel needed for the Calbayog bridges had been delivered before the end of May.

The fill for the new Calbayog market was completed about June 15, and construction of the market immediately begun.

The provincial officials are displaying a very satisfactory enthusiasm over the improvement of the Catbalogan school grounds, and four lawn-tennis courts are in process of construction. A quarter-mile rectangular track with quarter-circle corners is another of the features.

The north coast has the longest single stretch of road in the province, though it is a third-class road. In former years ferry barges, costing some ₱1,500 each, were placed at the large river crossings, but the barges lasted barely a year, proving the futility of such measures. However, the road is now connected up with bridges, with one or two exceptions, and automobile traffic has made its appearance in a modest way.

A day beacon has just been repaired over a new concrete base in the harbor of Guisan. This is an Insular project.

SORSOGON.

The baguio of June 18, 1914, caused considerable damage to surfacing all over the province, but particularly on the Bulan-Irocin Road, on which there have been several slides, mostly small, on five different kilometers. The storm center passed directly over the town of Sorsogon, wrecking several houses and causing a large amount of damage in the hemp fields. In Masbate the storm was not so severe, but heavy rains in Aroroy considerably damaged portions of the Colorado-Macatul Point Road, so that the regular auto traffic of the Colorado Mining Company has been held up.

The construction of culverts beyond the barrio of Guinjalón on the Sorsogon-Albay Road has progressed steadily, and a dirt road that will form the base of a future first-class road is keeping pace with the culverts.

There still remains about one-half kilometer to finish of the Sorsogon-Gubat Road, this on account of the baguio of June 18 which caused considerable damage to the subgrade, thus preventing the hauling of stone.

Bridge construction and grading has gone ahead steadily from Gubat to Bulusan. A survey has been made with a view to reducing the grades on kilometers 37 and 38, but further investigation is needed before any satisfactory location can be determined upon.

The construction of the Irocin central school (plan No. 7) has now been under way for a month and a half, and is progressing rapidly, due to a 1½-ton White truck having been hired from the Bureau of Public Works to haul school materials. Some trouble was had at first with the rear tires and wheels, but new wheels and tires have lately been placed on the machine and no more difficulties occur. Up to the end of last month the amount collected for fares for freight and passengers balanced approximately the total expenses, so that some 50 tons of school freight were hauled at no expense to project funds. The fact of this truck being a success will cause great changes in the Bulan district, as it was the opinion of the majority that a truck could not climb the hill on kilometer 18, a grade of 9 per cent for almost 1 kilometer. That the hill is not an impossible one, however, has been shown by this White truck, and several people are now considering the purchase of trucks.

Plans and estimates are now being prepared for the new provincial building, jail, and courthouse. The cost of these buildings will be close to ₱140,000.

A second artesian well has been completed in the town of Juban. It is 489 feet deep and pumps 8 gallons per minute.

A well is now being drilled close to the Colorado landing, the mining company guaranteeing one third of the cost, but up to the present, at 300 feet, nothing but solid rock has been found.

SURIGAO.

The delay in the granting of the ₱40,000 loan asked for by the provincial board for the continuation of the Surigao-Sison Road will result, it is feared, in deferring the construction until next year.

The Cansuran Gold Mining Company, employing on an average of 400 laborers daily, were in hopes that the Surigao-Sison Road could be finished as far as kilometer 9, thus connecting with the 5 kilometers of road constructed by them from that point to the mine. This mine is the first of its kind in the Philippines—hydraulic placer. It is understood that a hydroelectric plant costing ₱300,000 is under erection. The water for this plant is to be carried through open ditches and through tunnels for a distance of 2 kilometers into a storage reservoir 400 feet above the gold-bearing grounds. This work is under the direction of Mining Engineer J. J. Shaw.

Surfacing of the graded section of the Placer-Mainit Road, although its rate of progress has not come up to the original expectations, is proceeding more rapidly now, and will in all probability be finished by July 15. This setback may be attributed to an epidemic of small-pox in the town and surrounding country of Mainit.

Requisitions have been forwarded for materials for a standard plan No. 2 schoolhouse at Lingig. This barrio marks the boundary between Surigao and Moro Province on the east coast. It is 160 miles from the capital and extremely difficult to inspect, as transportation is available but once a year.

TARLAC.

The bridge of five 7-meter spans for the barrio of Bilad, municipality of Camiling, is nearing completion, all the five spans being completed already. The labor for this bridge is being done by contract.

A block of tiendas along the side of the Camiling market is almost finished; upon its completion the market can be handed over to the municipal authorities for occupation.

The construction of the Camiling presidencia is now going on by administration. The amount available for this construction is ₱32,031.03 and the estimated cost is ₱33,000. On account of rain, great difficulty is being experienced in transporting the materials for this building from Bautista, Pangasinan, to Camiling.

Work on the Tarlac-La Paz Road is almost at a standstill owing to the excessive rain. This work consists of the construction of 17 kilometers of first-class road, which goes through rich rice fields.

Bids for the construction of the Tarlac and Gerona markets have been opened, but no definite contract has been signed as yet. It is probable that these two constructions will be undertaken by contract.

The construction of the La Paz school is already started by administration. This building is a Bureau of Education standard plan No. 3. The work on a school of similar description in the barrio of Matatalaib of the municipality of Tarlac will also be started soon.

Owing to the locust campaign now going on in the province, road laborers are quite scarce.

TAYABAS.

Seven and one-half kilometers of first-class road have been constructed since January, 1914. This brings the total first-class roads up to 126½ kilometers. Lucban market, being constructed under administration, is 90 per cent completed.

The Candelaria and Mogpog schools will be completed and occupied July 5. Markets will be constructed in Lucena and Sariaya by administration.

Arthur F. Allen, contractor for five bridges on the Atimonan-Gumaca Road, is now engaged in driving and casting piles on two of the bridges.

The Sariaya waterworks is 95 per cent completed. The Lucena High School, plan 20, with two additional toilets, will be completed and dedicated July 15.

The municipalities of Lucena, Tayabas, and Pagbilao are intensely interested in securing a possible water supply.

Work on Torrijos school, Marinduque, is about 60 per cent completed.

ZAMBALES.

Loños bridge, a concrete structure with three 7-meter girder spans on reinforced-concrete pile bents, was completed in May. This is the first of this type of bridge constructed in the province.

Santa Rita bridge, three 7-meter girder spans also on reinforced-concrete pile bents, is about 85 per cent completed. No difficulty was encountered in driving the concrete piles for this bridge, as two steam pumps were used in connection with the jets.

The piles for Dalayap bridge No. 16.40 are being driven. The progress is rather slow due to a stratum of coarse gravel at the elevation of about 3 meters below low water.

Mamiranlit culvert, a 4 by 2 meter rectangular concrete structure, has been completed.

Work is progressing on the construction of Aninguay, Talus, Kapankian, and Kaluluanan culverts on the Iba-Subic Road.

The materials for Maculcul and Amungan bridges are on the ground. Actual construction will be started in a short time.

One abutment of Sacatihan bridge, an 8-meter deck girder structure, has been completed.

Word has been received from the Central Office that ₱30,000 of the ₱60,000 loan to this province will shortly be available for disbursement. This amount will be used in the construction of Pama-taun and Dinumagat bridges, each of six 7-meter girder spans on reinforced-concrete pile bents.

The artesian-well rig at work on the provincial grounds at Iba has drilled 600 feet, but the water is still salty. Should this well be successful, three more wells will be drilled, one each for the municipalities of Iba, Botolan, and Palauig.

Some progress has been made by the provincial treasurer in beautifying the provincial grounds at Iba. Many varieties of plants have been introduced, concrete benches have been built around the tennis courts, and an artistic concrete fountain has recently been finished. All of this work was done by prison labor. A concrete band stand is being constructed, also by prison labor. There is to be music twice a week in the completed structure.

The standard concrete outhouses for the San Narciso school have been completed at a cost of approximately ₱1,130.

GENERAL ITEMS.

ROAD PRIZES AWARDED BY THE ROAD COMMITTEE FOR THE FISCAL YEAR ENDED DECEMBER 31, 1914.

First prize, ₱15,000—Pangasinan.—All provinces having 100 kilometers or more of first-class roads will be rated on the actual condition of these roads throughout the year.

Second prize, ₱10,000—Leyte.—This prize will be given under the same conditions governing the first prize to the province securing the second highest rating.

Third prize, ₱5,000—Occidental Negros.—This prize to be given to the province actually transferring to the road and bridge fund the greatest percentage of its road and bridge fund from the general funds of the province and from the municipalities of the province.

TRUCK TRANSPORTATION IN BATANGAS PROVINCE.

A practical test on road-construction work of two Bureau of Public Works steam trucks, with two trailers each, has just been made. The trucks used were "Yorkshire steam wagons," Bureau of Public Works Nos. 102 and 106. Each wagon has a stone-carrying capacity of 2.50 cubic meters, two of the trailers carry 2.80 cubic meters each, and the two remaining carry 2.65 cubic meters each. All were used solely for the purpose of hauling stone from the rock crusher to the construction work on the Batangas-Ibaan Road.

The minimum length of haul was 6 kilometers, the maximum 9. The first 2 kilometers were level, the next 4 were up hill, the maximum grade being a short hill of perhaps 7 per cent. The remainder of these 4 kilometers was a succession of grades varying from 1 to 4 per cent. Once on the road under construction the grades varied from level to 6 per cent. The trucks hauled their loads over the finished road, dropped the trailers, which were loaded with screenings or medium-sized stone, at the end of the completed surfacing, and hauled their own loads to the end of the course of larger-sized stone. The maximum distance hauled by the trucks over the unfinished surfacing was perhaps 200 meters. The subgrade is of an adobe composition and after watering and rolling was temporarily as hard and compact as a finished road. The trucks had no difficulty whatever in turning on the subgrade. They could not have trouble, however, by turning around before being unloaded in order to avoid the necessity of pulling through the load just dumped.

The trucks were loaded at the crusher from an elevated bin. This operation took about twelve minutes per truck. Getting the truck into position, handling the trailers, including coupling and uncoupling, and loading the bunker with coal required approximately twenty minutes more. Truck No. 106 hauled two trailers at first, but when truck No. 102 was found to be unable to do the same thing the load for both was reduced to one trailer each. The trailers were loaded from the elevated bin under the rock crusher screen, when the trucks hauled two apiece. After the load was reduced the extra trailers were kept loaded in readiness for the next trip. Under these circumstances, they were sometimes loaded by hand from the storage pile. Both trucks and trailers had to be unloaded by hand. The trucks and two of the trailers had three dropping sides to each body and could thus be unloaded promptly. The two remaining trailers had removable tail boards only, hence they took much more time in unloading. Under favorable circumstances a train was unloaded and turned for the return trip in twenty-five minutes. Under difficult conditions, in locations on hillsides where part of the road was in fill and liable to slide under a heavy truck endeavoring to turn, and in long sections composed entirely of fill where the slopes were bound to be soft, this time rose to a maximum of ninety minutes. The time

required for taking on water, cleaning under fire box, etc., usually amounted to twenty minutes per round trip.

The period covered by this test was from April 13 to May 30, inclusive. The performance from April 1 to 12, inclusive, was disregarded for the reason that it took this length of time to get the men at the rock crusher and on the road-construction end accustomed to their parts in the handling of the work. Some difficulty was also experienced in getting a bin high enough to shoot the stone into the trucks. Truck No. 102 was not received until April 28, but it has been included in this report from the date it started operating.

The following is a synopsis of the performance of the trucks during the time covered by the cost accounts:

	Truck No. 102.	Truck No. 106.
1. Total number of working days	28	42
2. Total number of working days in operation	23	38
3. Total number of working days idle on account of necessary repairs	5	4
4. Total number of working days idle on account of weather or illness of driver		
5. Total number kilometers traveled	715	1,282
6. Total number cubic meters hauled	232	496
7. Average number kilometers traveled each day in operating	31.1	33.7
8. Average number cubic meters stones hauled each day in operation	10.1	13.1

^a Wheel broken on No. 106; wheel taken from No. 102 to keep No. 106 running.

Financial and performance statement.

	Truck No. 102.		Truck No. 106.	
	Total.	Cost per kilometer-meter.	Total.	Cost per kilometer-meter.
Cost of repairs:				
Bureau of Public Works machinist (salary and expenses)	₱74.77	₱0.0430		
Labor	36.29	.0209	₱21.26	₱0.0057
Materials	5.23	.0030	.34	.0001
Surcharges, 8 per cent	9.48	.0054	1.76	.0005
Cost of operation:				
Bureau of Public Works machinist (salary and expenses)			54.96	.0148
Labor	148.57	.0854	191.95	.0516
Coal	136.19	.0783	221.09	.0594
Lubricants	12.24	.0070	32.91	.0088
Freight, Camp one to Batangas	109.29	.0628	114.14	.0307
Miscellaneous	25.84	.0149	22.81	.0061
Surcharges, 8 per cent	35.22	.0202	51.99	.0140
Total	593.12	.3409	713.21	.1917

NOTE.—Rentals not included. Based on the proposition that each truck works 6 days each week and allowing no time for shipment, the cost per kilometer-meter, using the averages from No. 8 and the mean haul, would be increased ₱0.154, making the total cost per kilometer-meter ₱0.4949 for No. 102, and ₱0.1187 and ₱0.3104 for No. 106. Mean haul, 7.5 kilometers. Mean cost per kilometer-meter, ₱0.4026.

The total cost of transporting this amount of stone by carretones at the prices paid during the time the trucks were being used would have been ₱2,041.47, or ₱0.374 per kilometer-meter. This is based on a load of three-eighths cubic meter per trip, which amount has been found to be very close to that actually carried. Each carretón was furnished with a box holding 0.5 cubic meter, and by watching these boxes the amount actually carried was pretty accurately found. These boxes, incidentally, were at first cordially hated by the carretoneros, who have always claimed that they were carrying one-half meter of surfacing material. At first there was a strike on account of the boxes. Later they decided to use them, but claimed that their bulls could not pull the load. Strings of carts have been encountered on the road between the loading and unloading points with the drivers standing on their loads throwing handfuls of stone as far as possible on either side of the road. They seemed to be having a great lark seeing who could throw the most and the farthest. They finally got used to the work, however, and gradually formed the habit of carrying three-eighths cubic meter load without protestation expressed by word or by action along the road.

The presence of the trucks, however, has aided materially in keeping prices low for hauling stone by carretón as the length of haul increased. As can be seen from the above reports, the trucks have not worked any marked economies in stone transportation on this particular project. This poor showing is not due entirely to the trucks concerned, for there is no doubt but that these trucks can make over 34 kilometers per day under drivers who have sufficient interest in the performance of their machines. The great heat from the fire and

boiler, together with the hot weather of the dry season, seems to enervate the men in charge to such an extent that they will not work at their normal efficiency. After a short time the haul got to be so long that it became rather difficult to make three round trips per day, so that the drivers deliberately wasted enough time to cut their work down to two trips only. On account of the impossibility of securing men experienced in driving this type of truck, this situation had to be endured.

A trial of the better truck hauling two trailers and using two others at the loading point so as to save time in loading, is now being made on maintenance work. The better engineer and fireman have been given charge, while an extra experienced man has been kept available for emergency use. Unless unforeseen accidents occur, the showing under this arrangement will be very greatly improved.

FINANCIAL.

APPROPRIATIONS AND ALLOTMENTS SINCE APRIL 1, 1914,
FOR THE INSULAR YEAR BEGINNING JANUARY 1, 1914.

From Act 2378, section 1, paragraph (j), the Honorable the Secretary of Commerce and Police allotted the following sums as shown below:

Ambos Camarines	P10,000
Batangas	25,000
Capiz	10,000
Cavite	15,000
Iloilo	5,000
Laguna	20,000
La Union	27,000
Pangasinan	30,000
Rizal	40,000
For Bureau of Public Works (for experimental purposes, etc.)	18,000
Total	200,000

LOANS FOR ROADS, BRIDGES, SCHOOLS, MUNICIPAL AND
PROVINCIAL BUILDINGS, ETC., FROM APRIL 1, 1914,
TO JUNE 30, 1914.

Provinces and projects.	Act Nos.					Total.
	1323.	1728.	1729.	1749.	2083.	
Albay:						
Guinobatan-Jovellar bridges and culvert					P44,000	P44,000
Oas market	P7,500					7,500
Guinobatan central school		P2,000		P8,000		10,000
Ambos Camarines: Nabua market	8,000			8,000		16,000
Antique:						
Culasi central school		2,000		3,000		5,000
Bocboe, Malandag, Apgajan, and Bonkol bridges					50,000	50,000
Batangas:						
Tanauan market	12,500			12,500		25,000
Batangas market	25,000					25,000
Bulacan: Baliuag market	20,000					20,000
Capiz:						
Ibajay central school				4,000		4,000
Panitan bridge and bridges Nos. 28.18, 28.41, 28.04, 30.1, 30.48, 31.60, 31.98, 32.64, and 33.4					67,500	67,500
Provincial building		16,500	P38,500			55,000
Cavite:						
For the purpose of constructing a telephone line between the Ayuntamiento, Manila, and provincial building, Cavite		2,000		5,000		7,000
Julian bridge				10,000		10,000
Cebu: Osmeña waterworks system				100,000		100,000
Ilocos Norte:						
Laoag market	18,750	7,500		11,250		37,500
Pasuquin central school					3,000	3,000
Ilocos Sur:						
Vigan central school				5,000		5,000
Cabugao market	7,500			7,500		15,000
Candon market	10,000	4,000		6,000		20,000
Installation Vigan water system		7,000		28,000		35,000
Iloilo: Barotac Nuevo market		3,000		12,000		15,000
Laguna: San Pablo waterworks	25,000					25,000
La Union:						
San Fernando central school					5,000	5,000
Luna municipal building		1,800		7,200		9,000
Leyte:						
Barugo central school		2,000		5,000		7,000
Dapdap, Guinarona, and Mainit bridges		20,000			60,000	80,000
Nueva Ecija: Malimba, Tabuating, Baliuag, and Baloc-Cuyapo bridges					180,000	180,000
Occidental Negros: Alicante-Victorias and Victorias-Manapla bridges and culverts			24,000	36,000		60,000
Oriental Negros:						
Tanjay market		2,000		8,000		10,000
Guijulang market	7,500			7,500		15,000

Loans for roads, bridges, schools, etc.—Continued.

Provinces and projects.	Act No.					Total.
	1323.	1728.	1729.	1749.	2083.	
Pangasinan:						
For the purpose of constructing a bridge over the river between Bayambang and Bautista		10,000		20,000		30,000
San Fabian market	7,000	2,800		4,200		14,000
Mangaldan market	10,000			10,000		20,000
Tayug market		4,000		16,000		20,000
Rizal: Pasay market		5,000			20,000	25,000
Sorsogon: Provincial building and jail				59,000	71,000	130,000
Tarlac:						
Gerona market		3,600		14,400		18,000
Paniqui market		2,000				2,000
Tarlac market	11,000					11,000
Tayabas:						
Mauban market		3,600		14,400		18,000
Atimonan market		5,000		20,000		25,000
Candelaria central school				3,000		3,000
Manila: For permanent public works and improvements					147,200	147,200
Total	169,750	129,800	38,500	444,950	647,706	1,430,700

ALBAY.

For the purpose of constructing the culverts and bridges between kilometers 8 and 16 on the Guinobatan-Jovellar Road, a loan of ₱44,000 is hereby granted the Province of Albay payable in five annual installments due in three, four, five, six, and seven years, respectively, from the date of the loan, together with interest thereon, payable quarterly, at the rate of 3 per cent per annum.

Payments.	Act No. 2083.	
	Prin- cipal.	Interest.
First		P1,320
Second		1,320
Third	P5,000	1,320
Fourth	9,000	1,170
Fifth	10,000	900
Sixth	10,000	600
Seventh	10,000	300

Subject to the conditions contained in Resolution No. 30, series of 1914, of the municipality of Oas, and the letters of the Governor-General, dated March 11, 1913, May 14, 1913, and May 19, 1913, respectively, the Insular Treasurer is hereby authorized and directed to transfer to the Insular Government public works bonds (first series), now held as an investment of the city of Manila sewer and waterworks bonds sinking fund, to the par value of ₱8,000; and from the proceeds thus secured, a loan of ₱7,500 is hereby granted the municipality of Oas payable in five equal annual installments due in six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly at the rate of 4 per cent per annum.

Payments.	Act No. 1323.	
	Prin- cipal.	Interest.
First		P300
Second		300
Third		300
Fourth		300
Fifth		300
Sixth	P1,500	300
Seventh	1,500	240
Eighth	1,500	180
Ninth	1,500	120
Tenth	1,500	60

For the purpose of constructing a central school building, a loan of ₱10,000 is hereby granted the municipality of Guinobatan, Province of Albay, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act. No. 1728.		Act. No. 1749.	
	Prin- cipal.	Interest.	Prin- cipal.	Interest.
First	P1,000	P80		P320
Second	1,000	40		320
Third			P1,000	320
Fourth			1,000	280
Fifth			1,000	240
Sixth			1,000	200
Seventh			1,000	160
Eighth			1,000	120
Ninth			1,000	80
Tenth			1,000	40

AMBOS CAMARINES.

For the purpose of purchasing a market site and erecting modern market buildings, a loan of ₱8,000 is hereby granted the municipality of Nabua, Province of Ambos Camarines, payable in five equal annual installments due in one, two, three, four, and five years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1749.	
	Princi- pal.	Interest.
First	₱1,600	₱320
Second	1,600	256
Third	1,600	192
Fourth	1,600	128
Fifth	1,600	64

Subject to the conditions contained in Resolution No. 51, series of 1914, of the municipality of Nabua, and the letters of the Governor-General, dated March 11, 1913, May 14, 1913, and May 19, 1913, respectively, the Insular Treasurer is hereby authorized and directed to transfer to the Insular Government public works bonds (first series), now held as an investment of the city of Manila sewer and water-works bonds sinking fund, to the par value of ₱8,000; and from the proceeds thus secured, a loan of ₱8,000 is hereby granted the municipality of Nabua payable in five equal annual installments due in six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1323.	
	Princi- pal.	Interest.
First		₱320
Second		320
Third		320
Fourth		320
Fifth		320
Sixth	₱1,600	320
Seventh	1,600	256
Eighth	1,600	192
Ninth	1,600	128
Tenth	1,600	64

ANTIQUE.

For the purpose of constructing a modern central school building, a loan of ₱5,000 is hereby granted the municipality of Culasi, Province of Antique, payable in five equal annual installments due in one, two, three, four, and five years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 1749.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First	₱1,000	₱80		₱120
Second	1,000	40		120
Third			₱1,000	120
Fourth			1,000	80
Fifth			1,000	40

The letter of the Governor-General, dated March 18, 1912, granting a loan of ₱50,000 to the Province of Antique for the purpose of constructing the Bocboc and Malandag bridges, is hereby amended to read as follows:

"Referring to Resolution No. 117, current series, of the provincial board of Antique, I have the honor to state that, for the purpose of constructing the Bocboc, Malandag, Apgahan, and Boñgol bridges, a loan of ₱50,000 is hereby granted the said province, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 3 per cent per annum, and to request that the said amount be placed for disbursement to the credit of the provincial treasurer thereof, who should be advised accordingly. This loan will be made from the gold-standard fund, created by Act No. 2083. The annual payments, including interest due, when collected, will be credited as follows:

Payments.	Act No. 2083.	
	Princi- pal.	Interest.
First	₱5,000	₱1,500
Second	5,000	1,350
Third	5,000	1,200
Fourth	5,000	1,050
Fifth	5,000	900
Sixth	5,000	750
Seventh	5,000	600
Eighth	5,000	450
Ninth	5,000	300
Tenth	5,000	150

BATANGAS.

For the purpose of purchasing a market site and erecting modern market buildings thereon, a loan of ₱12,500 is hereby granted the municipality of Tanauan, Province of Batangas, payable in five equal annual installments due in one, two, three, four, and five years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1749.	
	Princi- pal.	Interest.
First	₱2,500	₱500
Second	2,500	400
Third	2,500	300
Fourth	2,500	200
Fifth	2,500	100

Subject to the conditions contained in Resolution No. 61, series of 1914, of the municipality of Batangas, and the letters of the Governor-General, dated March 11, 1913, May 14, 1913, and May 19, 1913, respectively, the Insular Treasurer is hereby authorized and directed to transfer to the Insular Government public works bonds (first series) now held as an investment of the city of Manila sewer and water-works bonds sinking fund, to the par value of ₱25,000; and from the proceeds thus secured, a loan of ₱25,000 is hereby granted the municipality of Batangas payable in five equal annual installments due in six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1323.	
	Princi- pal.	Interest.
First		₱1,000
Second		1,000
Third		1,000
Fourth		1,000
Fifth		1,000
Sixth	₱5,000	1,000
Seventh	5,000	800
Eighth	5,000	600
Ninth	5,000	400
Tenth	5,000	200

Subject to the conditions contained in Resolution No. 20, series of 1914, of the municipality of Tanauan, and the letters of the Governor-General dated March 11, 1913, May 14, 1913, and May 19, 1913, respectively, the Insular Treasurer is hereby authorized and directed to transfer to the Insular Government public works bonds (first series), now held as an investment of the city of Manila sewer and water-works bonds sinking fund, to the par value of ₱13,000; and from the proceeds thus secured, a loan of ₱12,500 is hereby granted the municipality of Tanauan payable in five equal annual installments due in six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly at the rate of 4 per cent per annum.

Payments.	Act No. 1323.	
	Princi- pal.	Interest.
First		₱500
Second		500
Third		500
Fourth		500
Fifth		500
Sixth	₱2,500	500
Seventh	2,500	400
Eighth	2,500	300
Ninth	2,500	200
Tenth	2,500	100

BULACAN.

Subject to the conditions contained in Resolution No. 34, series of 1914, of the municipality of Baliuag, and the letters of the Governor-General, dated March 11, 1913, May 14, 1913, and May 19, 1913, respectively, the Insular Treasurer is hereby authorized and directed to transfer to the Insular Government public works bonds (first series), now held as an investment of the city of Manila sewer and waterworks bonds sinking fund, to the par value of ₱20,000; and from the proceeds thus secured, a loan of ₱20,000 is hereby granted the municipality of Baliuag payable in five equal annual installments due in six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1323.	
	Principi-	Interest.
	pal.	
First.....		₱800
Second.....		800
Third.....		800
Fourth.....		800
Fifth.....		800
Sixth.....	₱4,000	800
Seventh.....	4,000	640
Eighth.....	4,000	480
Ninth.....	4,000	320
Tenth.....	4,000	160

CAPIZ.

For the purpose of constructing a modern central school building, a loan of ₱4,000 is hereby granted the municipality of Ibajay, Province of Capiz, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1749.	
	Principi-	Interest.
	pal.	
First.....	₱400	₱160
Second.....	400	144
Third.....	400	128
Fourth.....	400	112
Fifth.....	400	96
Sixth.....	400	80
Seventh.....	400	64
Eighth.....	400	48
Ninth.....	400	32
Tenth.....	400	16

Upon the recommendation of the Director of Public Works, contained in his indorsement dated May 23, 1914, and in accordance with the provisions of Resolution No. 154, current series, of the provincial board of Capiz, the letter of the Governor-General, dated February 13, 1912, is hereby amended to read as follows:

"I have the honor to state that, for the purpose of constructing the Panitan bridge and bridges Nos. 28.18, 28.41, 28.04, 30.1, 30.48, 31.60, 31.98, 32.64, and 33.4, a loan of ₱67,500 is hereby granted the Province of Capiz, payable in nine installments due in two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan together with interest, payable quarterly, at the rate of 3 per cent per annum, and to request that the said amount be placed for disbursement to the credit of the provincial treasurer thereof who should be advised accordingly. This loan will be made from the gold standard fund created by Act No. 2083."

By authority of the Governor-General.

In accordance with the provisions of Resolution No. 301, current series, of the provincial board of Capiz, the letter of the Governor-General, dated December 19, 1910, as amended December 19, 1912, and November 26, 1913, granting a loan of ₱55,000 to the Province of Capiz for the purpose of erecting a provincial building, is hereby further amended, effective December 23, 1914, to read as follows:

"I have to state that, for the purpose of erecting a provincial building, a loan of ₱55,000 is hereby granted the Province of Capiz, payable in seven installments, as follows, together with interest, payable quarterly, at the rate of 4 per cent per annum:

Dec. 23, 1911.....	₱11,000
Dec. 23, 1912.....	5,500
June 23, 1913.....	5,500
Dec. 23, 1913.....	5,500
Dec. 23, 1914.....	5,500
Dec. 23, 1915.....	11,000
Dec. 23, 1916.....	11,000

"It is requested that the said amount be placed for disbursement to the credit of the provincial treasurer of Capiz, who should be advised accordingly. Sixteen thousand five hundred pesos of this loan will be made from the insurance fund created by Act No. 1728, and ₱38,500 will be made from the sinking fund created by Act No. 1729. The annual payments, including interest due, when collected, will be credited as follows:

Payments.	Act No. 1728.		Act No. 1729.	
	Principi-	Interest.	Principi-	Interest.
	pal.		pal.	
Dec. 23, 1911.....	₱11,000	₱880		₱1,320
Dec. 23, 1912.....	5,500	440		1,320
June 23, 1913.....			₱5,500	110
Dec. 23, 1913.....			5,500	1,320
Dec. 23, 1914.....			5,500	1,100
Dec. 23, 1915.....			11,000	880
Dec. 23, 1916.....			11,000	440

CAVITE.

For the purpose of constructing a telephone line between the Ayuntamiento in Manila and the provincial building in the municipality of Cavite, a loan of ₱7,000 is hereby granted the Province of Cavite, payable in seven equal installments due in one, two, three, four, five, six, and seven years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 1749.	
	Principi-	Interest.	Principi-	Interest.
	pal.		pal.	
First.....	₱1,000	₱80		₱200
Second.....	1,000	40		200
Third.....			₱1,000	200
Fourth.....			1,000	160
Fifth.....			1,000	120
Sixth.....			1,000	80
Seventh.....			1,000	40

For the purpose of constructing the Julian bridge on the Imus-Dasmariñas Road, a loan of ₱10,000 is hereby granted the Province of Cavite payable in two equal annual installments due in four and five years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1749.	
	Principi-	Interest.
	pal.	
First.....		₱400
Second.....		400
Third.....		400
Fourth.....	₱5,000	400
Fifth.....	5,000	200

CEBU.

In accordance with the provisions of Resolution No. 256, current series, of the provincial board of Cebu, the letter of the Governor-General, dated March 14, 1911, granting a loan of ₱100,000 to the Province of Cebu for the purpose of assisting in the construction of "the Osmeña waterworks system," is hereby amended to read as follows:

"I have the honor to state that, for the purpose of aiding in the construction of "the Osmeña waterworks system," Cebu, Cebu, a loan of ₱100,000 is hereby granted the Province of Cebu, payable in seven installments due as follows: March, 1912, ₱20,000; March, 1913, ₱20,000; March, 1914, ₱20,000; June, 1915, ₱10,000; June, 1916; ₱10,000; June, 1917, ₱10,000; June, 1918, ₱10,000, together with interest payable quarterly, at the rate of 4 per cent per annum, and to request that the said amount be placed for disbursement to the credit of the provincial treasurer thereof who should be advised accordingly. This loan will be made from the sinking fund created by Act No. 1749.

"This loan is subject to all the conditions set forth in Resolution No. 128, of the provincial board of Cebu, dated February 10, 1911."

ILOCOS NORTE.

For the purpose of erecting modern market buildings, a loan of ₱18,750 is hereby granted the municipality of Laoag, Province of Ilocos Norte, payable in five equal annual installments due in one, two, three, four, and five years, respectively, from the date of the

loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 1749.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First	P3,750	P300		P450
Second	3,750	150		450
Third			P3,750	450
Fourth			3,750	300
Fifth			3,750	150

For the purpose of erecting a central school building, a loan of P3,000 is hereby granted the municipality of Pasuqui, Province of Ilocos Norte, payable in ten equal annual installments, due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 3 per cent per annum.

Payments.	Act No. 2083.	
	Princi- pal.	Interest.
First	P300	P90
Second	300	81
Third	300	72
Fourth	300	63
Fifth	300	54
Sixth	300	45
Seventh	300	36
Eighth	300	27
Ninth	300	18
Tenth	300	9

Subject to the conditions contained in Resolution No. 65, series of 1914, of the municipality of Laoag, and the letters of the Governor-General, dated March 11, 1913, May 14, 1913, and May 19, 1913, respectively, the Insular Treasurer is hereby authorized and directed to transfer to the Insular Government public works bonds (first series), now held as an investment of the city of Manila sewer and waterworks bonds sinking fund, to the par value of P19,000; and from the proceeds thus secured, a loan of P18,750 is hereby granted the municipality of Laoag, payable in five equal annual installments due in six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum. It is requested that on direction of the Executive Secretary, acting for and in behalf of the Municipal Board, the said amount be placed for disbursement to the credit of the provincial treasurer of Ilocos Norte, who should be advised accordingly. This loan will be made from the city of Manila sewer and waterworks bonds sinking fund created by Act No. 1323 of the Philippine Commission. The annual payments, including interest due, when collected, will be credited as follows:

Payments.	Act No. 1323.	
	Princi- pal.	Interest.
First		P750
Second		750
Third		750
Fourth		750
Fifth		750
Sixth	P3,750	750
Seventh	3,750	600
Eighth	3,750	450
Ninth	3,750	300
Tenth	3,750	150

ILOCOS SUR.

For the purpose of constructing a central school building, a loan of P5,000 is hereby granted the municipality of Vigan, Province of Ilocos Sur, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1749.	
	Princi- pal.	Interest.
First	P500	P200
Second	500	180
Third	500	160
Fourth	500	140
Fifth	500	120
Sixth	500	100
Seventh	500	80
Eighth	500	60
Ninth	500	40
Tenth	500	20

For the purpose of purchasing a market site and erecting modern market buildings, a loan of P7,500 is hereby granted the municipality of Cabugao, Province of Ilocos Sur, payable in five equal annual installments due in one, two, three, four, and five years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1749.	
	Princi- pal.	Interest.
First	P1,500	P300
Second	1,500	240
Third	1,500	180
Fourth	1,500	120
Fifth	1,500	60

For the purpose of purchasing a market site and erecting modern market buildings, a loan of P10,000 is hereby granted the municipality of Candon, Province of Ilocos Sur, payable in five equal annual installments due in one, two, three, four, and five years, respectively, from the date of the loan together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 1749.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First	P2,000	P160		P240
Second	2,000	80		240
Third			P2,000	240
Fourth			2,000	160
Fifth			2,000	80

For the purpose of installing a water system a loan of P35,000 is hereby granted the municipality of Vigan, Province of Ilocos Sur, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 1749.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First	P3,500	P280		P1,120
Second	3,500	140		1,120
Third			P3,500	1,120
Fourth			3,500	980
Fifth			3,500	840
Sixth			3,500	700
Seventh			3,500	560
Eighth			3,500	420
Ninth			3,500	280
Tenth			3,500	140

Subject to the conditions contained in Resolution No. 29, series of 1914, of the municipality of Cabugao, and the letters of the Governor-General, dated March 11, 1913, May 14, 1913, and May 19, 1913, respectively, the Insular Treasurer is hereby authorized and directed to transfer to the Insular Government public works bonds (first series), now held as an investment of the city of Manila sewer and waterworks bonds sinking fund, to the par value of P8,000; and from the proceeds thus secured, a loan of P7,500 is hereby granted the municipality of Cabugao, payable in five equal annual installments due in six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1323.	
	Princi- pal.	Interest.
First		P300
Second		300
Third		300
Fourth		300
Fifth		300
Sixth	P1,500	300
Seventh	1,500	240
Eighth	1,500	180
Ninth	1,500	120
Tenth	1,500	60

Subject to the conditions contained in Resolution No. 87, series of 1914, of the municipality of Candon, and the letters of the Gov-

ernor-General, dated March 11, 1913, May 14, 1913, and May 19, 1913, respectively, the Insular Treasurer is hereby authorized and directed to transfer to the Insular Government public works bonds (first series), now held as an investment of the city of Manila sewer and waterworks bonds sinking fund, to the par value of ₱10,000; and from the proceeds thus secured, a loan of ₱10,000 is hereby granted the municipality of Candon, payable in five equal annual installments due in six, seven, eight, nine, and ten years, respectively, from the date of the loan together with interest, payable quarterly at the rate of 4 per cent per annum.

Payments.	Act No. 1323.	
	Princi- pal.	Interest.
First.....		₱400
Second.....		400
Third.....		400
Fourth.....		400
Fifth.....		400
Sixth.....	₱2,000	400
Seventh.....	2,000	320
Eighth.....	2,000	240
Ninth.....	2,000	160
Tenth.....	2,000	80

ILOILO.

For the purpose of purchasing a market site and erecting modern market buildings, a loan of ₱15,000 is hereby granted the municipality of Barotac Nuevo, Province of Iloilo, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 1749.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First.....	₱1,500	₱120		₱480
Second.....	1,500	60		480
Third.....			₱1,500	480
Fourth.....			1,500	420
Fifth.....			1,500	360
Sixth.....			1,500	300
Seventh.....			1,500	240
Eighth.....			1,500	180
Ninth.....			1,500	120
Tenth.....			1,500	60

LAGUNA.

Subject to the conditions contained in Resolution No. 96, series of 1913, of the municipality of San Pablo and the letters of the Governor-General, dated March 11, 1913, May 14, 1913, and May 19, 1913, respectively, the Insular Treasurer is hereby authorized and directed to transfer to the Insular Government public works bonds (first series), now held as an investment of the city of Manila sewer and waterworks bonds sinking fund, to the par value of ₱25,000; and from the proceeds thus secured, a loan of ₱25,000 is hereby granted the municipality of San Pablo, payable in five equal annual installments due in six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1323.	
	Princi- pal.	Interest.
First.....		₱1,000
Second.....		1,000
Third.....		1,000
Fourth.....		1,000
Fifth.....		1,000
Sixth.....	₱5,000	1,000
Seventh.....	5,000	800
Eighth.....	5,000	600
Ninth.....	5,000	400
Tenth.....	5,000	200

LA UNION.

For the purpose of constructing a central school building, a loan of ₱5,000 is hereby granted the municipality of San Fernando, Province of La Union, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 3 per cent per annum.

Payments.	Act No. 2083.	
	Princi- pal.	Interest.
First.....	₱500	₱150
Second.....	500	135
Third.....	500	120
Fourth.....	500	105
Fifth.....	500	90
Sixth.....	500	75
Seventh.....	500	60
Eighth.....	500	45
Ninth.....	500	30
Tenth.....	500	15

For the purpose of reconstructing the municipal building, a loan of ₱9,000 is hereby granted the municipality of Luna, Province of La Union, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 1749.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First.....	₱900	₱72		₱288
Second.....	900	36		288
Third.....			₱900	288
Fourth.....			900	252
Fifth.....			900	216
Sixth.....			900	180
Seventh.....			900	144
Eighth.....			900	108
Ninth.....			900	72
Tenth.....			900	36

LEYTE.

For the purpose of constructing a central school building, a loan of ₱7,000 is hereby granted the municipality of Barugo, Province of Leyte, payable in seven equal annual installments due in one, two, three, four, five, six, and seven years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 1749.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First.....	₱1,000	₱80		₱200
Second.....	1,000	40		200
Third.....			₱1,000	200
Fourth.....			1,000	160
Fifth.....			1,000	120
Sixth.....			1,000	80
Seventh.....			1,000	40

For the purpose of constructing the Dapdap, Guinarona, and Mainit bridges on the Palo-South and the Tacloban-Carigara Roads, a loan of ₱80,000 is hereby granted the Province of Leyte, payable in eight annual installments due in one, two, three, four, five, six, seven, and eight years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of not to exceed 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 2083.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First.....	₱10,000	₱800		₱1,800
Second.....	10,000	400		1,800
Third.....			₱10,000	1,800
Fourth.....			10,000	1,500
Fifth.....			10,000	1,200
Sixth.....			10,000	900
Seventh.....			10,000	600
Eighth.....			10,000	300

NUEVA ECIJA.

Upon the recommendation of the Director of Public Works, contained in his indorsement of March 10, 1914, and in accordance with the provisions of Resolution No. 180, current series, of the provincial board of Nueva Ecija, the letter of the Governor-General, dated March 7, 1912, as amended by a letter of the Acting Governor-General, dated May 28, 1912, is hereby further amended to read as follows:

"SIR: I have the honor to state that, for the purpose of constructing the Malimba, kilometer 16, Tabuating, and Baliuag bridges, and the

bridges on the Baloc-Cuyapo section, all on the Manila-North Road, a loan of ₱180,000 is hereby granted the Province of Nueva Ecija, payable in nine equal annual installments due in two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 3 per cent per annum, and to request that the said amount be placed on April 1912, for disbursement to the credit of the provincial treasurer thereof, who should be advised accordingly. This loan will be made from the gold-standard fund created by Act No. 2083. The annual payments, including interest due, when collected, will be credited as follows:

Payments.	Act No. 2083.	
	Princi- pal.	Interest.
First		₱5,400
Second	₱20,000	5,400
Third	20,000	4,800
Fourth	20,000	4,200
Fifth	20,000	3,600
Sixth	20,000	3,000
Seventh	20,000	2,400
Eighth	20,000	1,800
Ninth	20,000	1,200
Tenth	20,000	600

OCCIDENTAL NEGROS.

For the purpose of constructing the culverts and bridges on the Alicante-Victorias and the Victorias-Manapla Roads, a loan of ₱60,000 is hereby granted the Province of Occidental Negros, payable in five equal annual installments due in one, two, three, four, and five years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 1749.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First	₱12,000	₱960		₱1,440
Second	12,000	480		1,440
Third			₱12,000	1,440
Fourth			12,000	960
Fifth			12,000	480

ORIENTAL NEGROS.

For the purpose of purchasing a market site and erecting modern market buildings, a loan of ₱10,000 is hereby granted the municipality of Tanjay, Province of Oriental Negros, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 1749.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First	₱1,000	₱80		₱320
Second	1,000	40		320
Third			₱1,000	320
Fourth			1,000	280
Fifth			1,000	240
Sixth			1,000	200
Seventh			1,000	160
Eighth			1,000	120
Ninth			1,000	80
Tenth			1,000	40

For the purpose of purchasing a market site and erecting modern market buildings thereon, a loan of ₱7,500 is hereby granted the municipality of Guijulan, Province of Oriental Negros, payable in five equal annual installments due in one, two, three, four, and five years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1749.	
	Princi- pal.	Interest.
First	₱1,500	₱300
Second	1,500	240
Third	1,500	180
Fifth	1,500	60

Subject to the conditions contained in Resolution No. 8, series of 1914, of the municipality of Guijulan, and the letters of the Governor-General, dated March 11, 1913, May 14, 1913, and May 19, 1913, respectively, the Insular Treasurer is hereby authorized and directed to transfer to the Insular Government public works bonds (first series), now held as an investment of the city of Manila sewer and waterworks bonds sinking fund, to the par value of ₱8,000; and from the proceeds thus secured, a loan of ₱7,500 is hereby granted the municipality of Guijulan, payable in five equal annual installments due in six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly at the rate of 4 per cent per annum.

Payments.	Act No. 1323.	
	Princi- pal.	Interest.
First		₱300
Second		300
Third		300
Fourth		300
Fifth		300
Sixth	₱1,500	300
Seventh	1,500	240
Eighth	1,500	180
Ninth	1,500	120
Tenth	1,500	60

PANGASINAN.

For the purpose of constructing a bridge over the river between the municipalities of Bayambang and Bautista, a loan of ₱25,000 is hereby granted the Province of Pangasinan, payable in four annual installments due in two, three, four, and five years, respectively, from the date of the loan as follows: Second year, ₱10,000; third year, ₱5,000; fourth year, ₱5,000; and fifth year, ₱5,000, together with interest thereon, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 1749.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First		₱400		₱600
Second	₱10,000	400		600
Third			₱5,000	600
Fourth			5,000	400
Fifth			5,000	200

For the purpose of constructing a bridge over the river between the municipalities of Bayambang and Bautista, a loan of ₱5,000 is hereby granted the municipality of Bayambang, Province of Pangasinan, payable in one, two, three, four, and five years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1749.	
	Princi- pal.	Interest.
First	₱1,000	₱200
Second	1,000	160
Third	1,000	120
Fourth	1,000	80
Fifth	1,000	40

For the purpose of purchasing a market site and erecting modern market buildings thereon, a loan of ₱7,000 is hereby granted the municipality of San Fabian, Province of Pangasinan, payable in five years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 1749.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First	₱1,400	₱112		₱168
Second	1,400	56		168
Third			₱1,400	168
Fourth			1,400	112
Fifth			1,400	56

For the purpose of purchasing a market site and erecting modern market buildings thereon, a loan of ₱10,000 is hereby granted the

municipality of Magaldan, Province of Pangasinan, payable in five equal annual installments due in one, two, three, four, and five years, respectively, from the date of the loan, together with interest, payable quarterly at the rate of 4 per cent per annum.

Payments.	Act No. 1749.	
	Princi- pal.	Interest.
First.....	P2,000	P400
Second.....	2,000	320
Third.....	2,000	240
Fourth.....	2,000	160
Fifth.....	2,000	80

For the purpose of purchasing a market site and erecting modern market buildings, a loan of ₱20,000 is hereby granted the municipality of Tayug, Province of Pangasinan, payable in ten equal annual installments, due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 1749.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First.....	P2,000	P160		P640
Second.....	2,000	80		640
Third.....			P2,000	640
Fourth.....			2,000	560
Fifth.....			2,000	480
Sixth.....			2,000	400
Seventh.....			2,000	320
Eighth.....			2,000	240
Ninth.....			2,000	160
Tenth.....			2,000	80

Subject to the conditions contained in Resolution No. 51, series of 1914, of the municipality of Mangaldan, and the letters of the Governor-General, dated March 11, 1913, May 14, 1913, and May 19, 1913, respectively, the Insular Treasurer is hereby authorized and directed to transfer to the Insular Government public works bonds (first series), now held as an investment of the city of Manila sewer and waterworks bonds sinking fund, to the par value of ₱10,000; and from the proceeds thus secured, a loan of ₱10,000 is hereby granted the municipality of Mangaldan, payable in five equal annual installments due in six, seven, eight, nine, and ten years, respectively, from the date of the loan together with interest, payable quarterly, at the rate of 4 per cent per annum. It is requested that on direction of the Executive Secretary, acting for and in behalf of the Municipal Board, the said amount be placed for disbursement to the credit of the provincial treasurer of Pangasinan, who should be advised accordingly. This loan will be made from the city of Manila sewer and waterworks bonds sinking fund created by Act No. 1323 of the Philippine Commission. The annual payments, including interest due, when collected, will be credited as follows:

Payments.	Act No. 1323.	
	Princi- pal.	Interest.
First.....		P400
Second.....		400
Third.....		400
Fourth.....		400
Fifth.....		400
Sixth.....	P2,000	400
Seventh.....	2,000	320
Eighth.....	2,000	240
Ninth.....	2,000	160
Tenth.....	2,000	80

Subject to the conditions contained in Resolution No. 37, series of 1914, of the municipality of San Fabian, and the letters of the Governor-General, dated March 11, 1913, May 14, 1913, and May 19, 1913, respectively, the Insular Treasurer is hereby authorized and directed to transfer to the Insular Government public works bonds (first series), now held as an investment of the city of Manila sewer and waterworks bonds sinking fund, to the par value of ₱7,000; and from the proceeds thus secured, a loan of ₱7,000 is hereby granted the municipality of San Fabian, payable in five equal annual installments due in six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly at the rate of 4 per cent per annum. It is requested that on direction of the Executive Secretary, acting for and in behalf of the Municipal Board, the said

amount be placed for disbursement to the credit of the provincial treasurer of Pangasinan, who should be advised accordingly. This loan will be made from the city of Manila sewer and waterworks bonds sinking fund created by Act No. 1323 of the Philippine Commission. The annual payments, including interest due, when collected, will be credited as follows:

Payments.	Act No. 1323.	
	Princi- pal.	Interest.
First.....		P280
Second.....		280
Third.....		280
Fourth.....		280
Fifth.....		280
Sixth.....	P1,400	280
Seventh.....	1,400	224
Eighth.....	1,400	168
Ninth.....	1,400	112
Tenth.....	1,400	56

RIZAL.

For the purpose of purchasing a market site and erecting modern market buildings thereon, a loan of ₱25,000 is hereby granted the municipality of Pasay, Province of Rizal, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of not to exceed 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 2083.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First.....	P2,500	P200		P600
Second.....	2,500	100		600
Third.....			P2,500	600
Fourth.....			2,500	525
Fifth.....			2,500	450
Sixth.....			2,500	375
Seventh.....			2,500	300
Eighth.....			2,500	225
Ninth.....			2,500	150
Tenth.....			2,500	75

SORSOGON.

For the purpose of purchasing a site and erecting thereon a modern provincial building and a jail, a loan of ₱130,000 is hereby granted the Province of Sorsogon, payable in ten annual installments due as follows: First year, ₱11,000; second year, ₱11,000; third year, ₱12,000; fourth year, ₱12,000; fifth year, ₱13,000; sixth year, ₱13,000; seventh year, ₱14,000; eighth year, ₱14,000; ninth year, ₱15,000; and the tenth year, ₱15,000; together with interest, payable quarterly, at the rate of not to exceed 4 per cent per annum. It is requested that the said amount be placed for disbursement to the credit of the provincial treasurer of Sorsogon, who should be advised accordingly. Fifty-nine thousand pesos of this loan will be made from the friar lands bonds sinking fund created by Act No. 1749, and ₱71,000 from the gold-standard fund created by Act No. 2083. The loan from the gold-standard fund will bear interest at the rate of 3 per cent per annum, and the loan from the fund created by Act No. 1749 will bear interest at the rate of 4 per cent per annum. The annual payments, including interest due, when collected, will be credited as follows:

Payments.	Act No. 1749.		Act No. 2083.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First.....	P11,000	P2,360		P2,130
Second.....	11,000	1,920		2,130
Third.....	12,000	1,480		2,130
Fourth.....	12,000	1,000		2,130
Fifth.....	13,000	520		2,130
Sixth.....			P13,000	2,130
Seventh.....			14,000	1,740
Eighth.....			14,000	1,320
Ninth.....			15,000	900
Tenth.....			15,000	450

TARLAC.

For the purpose of purchasing a market site and erecting modern market buildings, a loan of ₱18,000 is hereby granted the municipality of Gerona, Province of Tarlac, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten

years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 1749.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First	P1,800	P142		P576
Second	1,800	72		576
Third			P1,800	576
Fourth			1,800	504
Fifth			1,800	432
Sixth			1,800	360
Seventh			1,800	288
Eighth			1,800	216
Ninth			1,800	144
Tenth			1,800	72

For the purpose of purchasing additional land to extend its present market site, a loan of ₱2,000 is hereby granted the municipality of Paniqui, Province of Tarlac, payable in one installment due in two years from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.	
	Princi- pal.	Interest.
First		P80
Second	P2,000	80

Subject to the conditions contained in Resolution No. 19, series of 1914, of the municipality of Tarlac, and the letters of the Governor-General, dated March 11, 1913, May 14, 1913, and May 19, 1913, respectively, the Insular Treasurer is hereby authorized and directed to transfer to the Insular Government public works bonds (first series), now held as an investment of the city of Manila sewer and waterworks bonds sinking fund, to the par value of ₱11,000; and from the proceeds thus secured, a loan of ₱11,000 is hereby granted the municipality of Tarlac, payable in five equal annual installments due in six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1323.	
	Princi- pal.	Interest.
First		P440
Second		440
Third		440
Fourth		440
Fifth		440
Sixth	P2,200	440
Seventh	2,200	352
Eighth	2,200	264
Ninth	2,200	176
Tenth	2,200	88

TAYABAS.

For the purpose of purchasing a market site and erecting modern market buildings, a loan of ₱18,000 is hereby granted the municipality of Mauban, Province of Tayabas, payable in ten equal installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 1749.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First	P1,800	P144		P576
Second	1,800	72		576
Third			P1,800	576
Fourth			1,800	504
Fifth			1,800	432
Sixth			1,800	360
Seventh			1,800	288
Eighth			1,800	216
Ninth			1,800	144
Tenth			1,800	72

For the purpose of purchasing a market site and erecting modern market buildings, a loan of ₱25,000 is hereby granted the municipality of Atimonan, Province of Tayabas, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1728.		Act No. 1749.	
	Princi- pal.	Interest.	Princi- pal.	Interest.
First	P2,500	P200		P800
Second	2,500	100		800
Third			P2,500	800
Fourth			2,500	700
Fifth			2,500	600
Sixth			2,500	500
Seventh			2,500	400
Eighth			2,500	300
Ninth			2,500	200
Tenth			2,500	100

For the purpose of completing the central school building a loan of ₱3,000 is hereby granted the municipality of Candelaria, Province of Tayabas, payable in ten equal annual installments due in one, two, three, four, five, six, seven, eight, nine, and ten years, respectively, from the date of the loan, together with interest, payable quarterly, at the rate of 4 per cent per annum.

Payments.	Act No. 1749.	
	Princi- pal.	Interest.
First	P300	P120
Second	300	108
Third	300	96
Fourth	300	84
Fifth	300	72
Sixth	300	60
Seventh	300	48
Eighth	300	36
Ninth	300	24
Tenth	300	12

MANILA.

With reference to the communication of His Excellency the Governor-General, dated August 3, 1912, granting a loan of ₱736,000 to the city of Manila for permanent public works and improvements, I have to request that ₱73,600 of that amount be placed to the credit of the city of Manila immediately. This installment of the loan will be made from the gold-standard fund, created by Act No. 2083, and will be repayable on August 14, 1921. The repayment should be credited to the gold-standard fund, created by Act No. 2083.

By authority of the Governor-General.

With reference to the communication of His Excellency the Governor-General, dated August 3, 1912, granting a loan of ₱736,000 to the city of Manila for permanent public works and improvements, I have to request that ₱73,600 of that amount be placed to the credit of the city of Manila immediately. This installment of the loan will be made from the gold-standard fund, created by Act No. 2083, and will be repayable on August 14, 1922. The repayment should be credited to the gold-standard fund, created by Act No. 2083.

According to the records of this office, this is the tenth and last installment of the loan of ₱736,000 granted the city of Manila on August 3, 1912.

By authority of the Governor-General.

SELECTED.

IF YOU ONLY TRY.

Somebody said that "it couldn't be done,"
But he with a chuckle replied
That maybe it couldn't but he would be one
Who wouldn't say so until he tried.
So he buckled right in, with a grin
On his face. If he worried he hit it;
And started to sing as he tackled the thing
That couldn't be done—and he did it.
Somebody scoffed—"Oh, you'll never do that,
At least no one ever has done it,
But he took off his coat and he took off his hat
And the first thing he knew he'd begun it.
With a lift of his chin and a bit of a grin,
Without any doubts or quiddit,
He started to sing as he tackled the thing
That couldn't be done—and he did it.
There are thousands to tell you it cannot be done,
There are thousands to prophesy failure,
There are thousands to point out to you, one by one,
The dangers that await to assail you.
But buckle right in with a bit of a grin,
Then take off your coat and go to it;
Just start in to sing as you tackle the thing
That "cannot be done"—and you'll do it.

—(Contributed.)

APPENDIX A.

CIRCULAR LETTERS ISSUED BY THE CONSTRUCTING DIVISION FROM OCTOBER 1, 1913, TO JUNE 20, 1914.

MANILA, October 13, 1913.

Provincial Division Circular No. 119.

SIR: I am forwarding under separate cover a copy of the new Engineer's Handbook. Suggestions and comment are requested in order that the final edition may be made complete in every respect.

The requirements as outlined therein will govern in all cases except where written instructions to the contrary are hereafter given. Special attention is invited to the conditions under which clay may be used as a binder on road construction, repair and maintenance. The promiscuous use of an excessive amount of clay-binder will not be tolerated and division engineers will report all such cases for administrative action.

The handbooks have been consecutively numbered, their issue is being recorded and an accounting will be required accordingly. If it is deemed advisable to have other employees of your district supplied with a copy, their names and addresses should be submitted.

For the Director:

E. J. WESTERHOUSE,
Chief Division Engineer.

To all DISTRICT ENGINEERS and
DIVISION ENGINEERS.

MANILA, October 22, 1913.

Provincial Division Circular No. 120.

SIR: Your attention is invited to the attached Provincial Division Circular No. 288 of the Bureau of Audits on the subject of traveling expenses, Bureau of Public Works employees. You are directed to carefully observe and comply with all the instructions contained therein.

For the Director:

E. J. WESTERHOUSE,
Chief Division Engineer.

To all DISTRICT ENGINEERS and
DIVISION ENGINEERS.

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,
BUREAU OF AUDITS,
Manila, October 17, 1913.

PROVINCIAL DIVISION CIRCULAR No. 288.

SUBJECT: *Traveling Expenses: Bureau of Public Works employees.*

Provincial treasurers:

The following regulations will be enforced in making payments of salary and traveling expenses to employees of the Bureau of Public Works during periods of travel outside of the district to which they are assigned:

(1) Vouchers covering salary and traveling expenses of district engineers, assistant engineers, and other employees assigned to provincial work and having an Insular status as defined in paragraph 4 of Provincial Division Circular No. 202, during periods of travel outside of the district to which they are assigned, will be supported by a copy of a travel order, authorizing the travel outside of the district, signed by the Director of Public Works or by his authorized representative, who will sign "For the Director (title)." A copy of the Director's authorization to sign travel orders as prescribed herein will accompany the travel order in case the latter is signed by some one other than the chief engineer, the chief division engineer, or a division engineer. The travel order will state the time during which travel outside of the district will be allowed, and also the project or account to which such travel is chargeable. In cases where the time specified in the travel order is exceeded, a supplemental travel order shall be furnished, or refund of salary and traveling expenses for the unauthorized period may be required.

(2) No travel order will be required in support of payments of salary and traveling expenses of employees having an Insular status, and assigned to provincial work, in cases where the most direct or advantageous route between points within the district is through outside territory.

(3) Vouchers covering salary and traveling expenses of Bureau of Public Works' employees having a provincial status, during periods of travel outside of the district to which they are assigned, will be supported by a travel order signed by the district engineer. The travel order will state the time during which travel outside of

the district is authorized, and will also state the project or account to which the salary and traveling expenses are chargeable.

(4) Paragraph 18 of Provincial Division Circular No. 202 is hereby amended to read as follows:

"Vouchers covering salary and traveling expenses of all Bureau of Public Works' employees having an Insular status, while enroute to station upon appointment or transfer from points outside the province, will require the approval of the Director of Public Works before payment. Vouchers covering the salary and traveling expenses of employees having a provincial status, while enroute to station upon appointment or transfer from points outside the province, will require the approval of the district engineer."

(5) The traveling expenses of Bureau of Public Works' employees while en route from a provincial station to Manila to take leave of absence will in no case be a charge against provincial funds; half salary, however, under the provisions of section 23 of Act 1698 may be so charged.

(6) The cost of transportation and half salary due a Bureau of Public Works' employee upon original appointment or upon return from accrued leave of absence will be paid by the province to which he is assigned, and will be charged to account A-7-1, Engineering Expenses. If the employee is transferred before he has rendered two years' service in the province, refund of the proportional share of the amount thus paid will be secured from the province or Bureau to which he is transferred. In cases where an employee has been assigned to duty in the office of the Bureau of Public Works and the cost of transportation and half salary have been paid by that bureau, if the employee is transferred to a province before he has rendered two years' service in the Bureau, refund of the proportional share of the amount paid may likewise be secured from the province to which he is transferred. Reimbursement of that portion of such an employee's traveling expenses which is due at the expiration of two years' service will be made by the province to which the employee is assigned at the time such reimbursement becomes due.

(7) Any salary due a Bureau of Public Works' employee on account of vacation leave taken in connection with accrued leave will be made a charge against the branch of the Government to which the employee was assigned at the time the leave was taken.

(Sgd.) C. H. FRENCH,
Insular Auditor.

Concurred in:

(Sgd.) F. W. CARPENTER, *Executive Secretary.*
(Sgd.) WARWICK GREENE, *Director of Public Works.*

MANILA, October 23, 1913.

Provincial Division Circular No. 121.

SIR: I have to advise that it is highly essential for this bureau to have absolutely correct information as to the amount of the provincial surcharge. The central office is frequently handicapped in its work in connection with schools, markets, presidencias, bridges, etc., through inaccurate data as to the actual current provincial surcharge.

You are directed to furnish immediate information as to the provincial surcharge in actual effect October 1, 1913, and to promptly keep the Bureau advised of any increase or reduction in the provincial surcharge, which may be authorized by the district auditor and provincial treasurer in the future.

For the Director:

E. J. WESTERHOUSE,
Chief Division Engineer.

To all DISTRICT ENGINEERS and
DIVISION ENGINEERS.

MANILA, October 24, 1913.

Provincial Division Circular No. 122.

SIR: Supplementary to our letter dated December 7, 1910, containing an agreement signed by C. M. Cotterman, Director of Posts, and C. E. Gordon, division engineer, for and on behalf of the Director of Public Works, in relationship to the location of telegraph and telephone poles on public roads; also to Circular No. 118 under

date of August 20, 1913, on removal of telegraph and telephone poles; also to "Tree planting along public roads," as published on page 5 of the QUARTERLY BULLETIN of October 1, 1912, issue; the following has been agreed upon by the Director of Posts, and the Director of Public Works:

1. The care and pruning of trees set out along public highways or those left upon the right-of-way by the district engineer for ornamental or other purposes, be subject to the district engineer's supervision and direction; provided that the local representative of the Director of Posts may in emergency cases, where there is interference with the telegraph or telephone service, remove the interfering leaves or branches at a point adjacent to the interference without prior notice to the district engineer.

2. The attached blue print¹ of approved road sections, showing the location of trees and telegraph line as they relate to each other, will govern in the future for the location of trees and telegraph or telephone poles on improved roads.

For the Director:

E. J. WESTERHOUSE,
Chief Division Engineer.

Approved:

WARWICK GREENE, *Director of Public Works.*
C. M. COTTERMAN, *Director of Posts.*

MANILA, December 6, 1913.

Provincial Division Circular No. 123.

SIR: Your attention is invited to the following extracts of a communication received from Dr. Alvin J. Cox, Acting Director of the Bureau of Science.

"The presence of a white powder on galvanized iron is generally an oxide or carbonate of zinc. The presence of the powder indicates that the galvanized iron is not a new sample and that it has been exposed to atmospheric or other corrosive influences. It does not necessarily mean that the particular sample should be rejected. Any sample of galvanized iron will oxidize on exposure to atmospheric conditions. Under the influence of moisture and the oxygen of the air zinc will oxidize. If the conditions are such that the oxide is formed in a loose fashion, the adhering coating will be washed off by heavy rains and further oxidation will follow. If the coating adheres closely a certain amount of zinc oxide will form, the presence of which will prevent further oxidation. The mere presence of zinc oxide does not indicate poor material or a state of undesirable deterioration. In order to pass judgment upon the same, we must take into consideration the workmanship, the thinness of the zinc surfacing, the quantity of oxide present, and the time and conditions under which it is formed. In contact with iron zinc oxide accelerates the corrosion of the former so that if the coating of zinc contain pinholes one would expect corrosion of the iron to be accelerated catalytically. The layer of zinc oxide is likely lighter and protects the metal better if it forms slowly, so that the coating formed when the galvanized iron is exposed to the air under shelter is likely to produce the least deterioration."

From this it is entirely apparent that galvanized-iron roofing, when left in its original cases and subject to moisture, is likely to deteriorate. District engineers are therefore directed to issue the necessary instructions and take every precaution to have galvanized-iron roofing while being stored in its original cases or otherwise, set on end in order that zinc oxide may form gradually, thereby preventing further oxidation.

For the Director:

E. J. WESTERHOUSE,
Chief Division Engineer.

To all DISTRICT ENGINEERS and
DIVISION ENGINEERS.

MANILA, December 9, 1913.

Provincial Division Circular No. 124.

SIR: Your attention is invited to the attached Executive Order No. 103. You are directed to bring the provisions of this executive order to the attention of all employees of the Bureau of Public Works in your province and to impress upon all such employees the absolute necessity of complying with both the letter and the spirit of Executive Order No. 103.

For the Director:

E. J. WESTERHOUSE,
Chief Division Engineer.

To all DISTRICT ENGINEERS and
DIVISION ENGINEERS.

¹ Not printed.

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,
EXECUTIVE BUREAU,
Manila, December 1, 1913.

EXECUTIVE ORDER }
No. 103. }

For the future, the executive authority given by the law to permit, in certain cases, Government employees to engage in private business outside of their official duties, will not be favorably exercised except under most exceptional circumstances. It is not intended by this that all employees of the Government who have engaged in private business under executive permission conferred in accordance with the law should sever their connection with such business enterprises; any such cases would be considered for revocation of the permission already extended only where such business activities impair the efficiency of the Government employee during his official work, tend to influence improperly his official actions, secure to him any unfair advantage in connection with his official position, or otherwise bring discredit upon the Government. On the other hand, it should be understood that for the future such business employment outside of official life is considered to affect unfavorably the capacity of the employee to perform the Government services for which he is drawing his salary; his entire time and strength is due to the Government even though he may be called upon to give such time and strength outside of office hours.

No employee will be allowed to take any part in the management of any business or engage in outside clerical or sedentary employment or any profession or employment which would bring him into competition with professional or business men, and permission to accept employment will as a rule be limited to that involving outdoor labor which would better the physical condition of the employee and to teaching engineering, stenography, and such other branches as would be of benefit to the Government or the community, the time to be devoted to this teaching not to exceed that prescribed for the Government night schools (one and one-half hours daily).

Permission for all investments made in the Philippine Islands must be obtained from the Governor-General or proper Secretary of Department. No request will be approved to make any investment which might bring the employee's private interests into real or apparent conflict with his public duties or in any way influence him in the discharge of his duties, or to make any investment which might interest the employee in an undertaking with which his public duty is connected or which might cause criticism of the Government or the employee. Employees shall not obtain concessions from the Government or own stock in companies holding concessions.

Loans from subordinates to superiors and loans on personal security are absolutely prohibited. Loans on real estate with interest at 10 per cent per annum or less will usually be approved under proper conditions.

Any violation of the provisions of this order or acceptance of employment or making investments or loans without the required permission will be sufficient cause for removal from the service.

FRANCIS BURTON HARRISON,
Governor-General.

MANILA, December 19, 1913.

Provincial Division Circular No. 125.

SIR: Herewith is Circular No. 50 calling attention to the existing law and regulations with respect to the indulgence by certain Government employees in political activities. District engineers will bring this circular to the individual attention of all employees under their charge. Severe action will follow any violation of the intent of this circular.

For the Director:

E. J. WESTERHOUSE,
Chief Division Engineer.

To all DIVISION ENGINEERS,
DISTRICT ENGINEERS,
TRAVELING INSPECTOR, and
MACHINERY INSPECTOR.

CIRCULAR No. 50.

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,
BUREAU OF CIVIL SERVICE,
Manila, December 9, 1913.

To Chiefs of Bureaus and Offices:

I have the honor to invite attention to the provisions of section 29 of Act 1582, as amended by Act 1948, regarding participation in elections by officers or employees; section 10 of Act 1698, relating to political contributions and political services; section 1 of Civil Service Rule XIII, providing that "No person in the Philippine civil service shall use his official authority or official influence to coerce the political action of any other person or body;" and section 6 of Civil Service

Rule XIII, which provides that "Pernicious political activity, offensive political partisanship, or conduct prejudicial to the best interest of the service * * * may be considered reasons demanding proceedings to remove for cause, to reduce in class or grade, or to inflict other punishment as provided by law in the discretion of the Governor-General or proper head of Department. No chief of a Bureau or Office shall knowingly continue in the public service any subordinate officer or employee who is inefficient or who is guilty of any of the above-named derelictions, without submitting the facts through the Director of Civil Service to the Governor-General or proper head of Department."

The provisions of the law and rules above cited apply equally to the members of the classified and of the unclassified service in all the branches of the civil service of the Philippine Islands, except elected officers and officers appointed by the President of the United States.

Prohibited political activity consists among other things in taking part in political management or political campaigns, being a delegate to any political convention or a member of any political committee or directorate or of any political club or other similar political organization, making speeches or canvassing in the interests of any party or candidate, soliciting or receiving contributions for political purposes either directly or indirectly, or becoming prominently identified with any political movement, party, or faction, or with the success or failure of any candidate for election to public office.

The prohibitions, herein contained apply to political activity with respect to the political parties of the United States as well as of the Philippine Islands.

It is requested that this circular be brought to the notice of all officers and employees under your jurisdiction, classified or unclassified, permanent or temporary.

Very respectfully,

B. L. FALCONER,
Director of Civil Service.

Approved:

FRANCIS BURTON HARRISON, Governor-General.

MANILA, January 8, 1914.

Provincial Division Circular No. 126.

SIR: Supplementary to Provincial Division Circular No. 32, outlining method of requesting designation of first-class roads from provincial boards, effective June 30 and December 31, respectively, of each calendar year, you are directed that for the request effective June 30, 1914, and thereafter, that the length of the roads requested for such designation be reduced to the nearest tenth of a kilometer, and in all cases that the length of the roads requested for designation as first-class contain one decimal only. Care is directed that these instructions are observed.

For the Director:

E. J. WESTERHOUSE,
Chief Division Engineer.

To all DISTRICT ENGINEERS and
DIVISION ENGINEERS.

MANILA, January 28, 1914.

Provincial Division Circular No. 127.

SIR: Attention is invited to the variation in the effective width of the various brands of galvanized-iron roofing supplied by the Purchasing Agent. These widths are for what is ordinarily known as 36-inch smooth, galvanized-iron sheets, before corrugating, and generally listed as 32 inches in width. The actual and effective widths are as follows:

Kind of iron.	Actual width after corrugating.	Effective width with number of corrugation side laps.		
		1½.	2.	2½.
	Inches.	Inches.	Inches.	Inches.
Apollo	31½	27½	26½	25
American ingot	31	27	25½	23½
Newport	32½	28½	27½	26
Three Crown	32½	28½	27½	26

Bills of material for galvanized-iron roofing should be prepared, taking into account the effective widths as herein given. This is absolutely essential in order to prevent both over and under estimation of the amount of roofing required.

The variation in width of sheets and depth of corrugations makes it imperative that only one brand of iron be used for the same roof.

For the Director:

E. J. WESTERHOUSE,
Chief Division Engineer.

To all DISTRICT ENGINEERS and
DIVISION ENGINEERS.

MANILA, February 3, 1914.

Provincial Division Circular No. 128.

SIR: Attention is invited to the subjoined excerpt from an indorsement received under date of January 27, 1914, from the Director of Civil Service.

"The Civil Service Act and Rules require that selection for permanent work shall be made from the first three names on the eligible register. Where the work is to last for a limited period only, selection of any eligible may be made without regard to standing on the register. If it were possible to select for temporary employment, an eligible low on the register and later, on account of experience gained as a temporary employee, certify him for permanent appointment although very low on the register, the provision of the law that eligibles with the highest ratings shall be given preference in permanent appointment would be of no effect.

Where positions are permanent in character, they should not be filled by the temporary employment of persons low on the register, as the time spent in teaching them the duties of the positions is lost and the persons, who, under the law, are entitled to permanent positions and would probably have been more satisfactory if they had been chosen, are deprived of their legal rights."

All district engineers are enjoined that in securing employees and forwarding such appointments, the letter and the spirit of the Civil Service law, as set out by the Director of Civil Service above quoted be followed.

For the Director:

E. J. WESTERHOUSE,
Chief Constructing Engineer.

To all DISTRICT ENGINEERS and
DIVISION ENGINEERS.

MANILA, February 24, 1914.

Provincial Division Circular No. 129.

SIR: I have the honor to advise that the designing division of this Bureau can now furnish the large colored road map (size about 82 by 53 inches) at a cost not exceeding ₱10.

You are requested to communicate this to the various officials of your district, both Insular and provincial, in order that those desiring copies of these maps may requisition on this bureau in the regular form.

For the Director:

E. J. WESTERHOUSE,
Chief Constructing Engineer.

To all DISTRICT ENGINEERS and
DIVISION ENGINEERS.

MANILA, March 6, 1914.

Constructing Division Circular No. 130.

SIR: Attention is invited to the subjoined excerpt from a communication received March 3, 1914, from the Acting Director of Education:

"That the use of oil be discontinued in the construction of school buildings and that the interior and exterior woodwork of all school buildings be given at least two good coats of paint. A shade or tint of green is recommended for all interior work. It is requested that these changes be put into effect at the earliest possible date."

All future school construction and all school buildings which are at present under way, where possible and where the funds will permit, should be finished as set out above in the quotation from the communication from the Director of Education. Care is enjoined that this substitution in the finishing of school buildings be brought to the attention of your office force.

For the Director:

E. J. WESTERHOUSE,
Chief Constructing Engineer.

To all DISTRICT ENGINEERS,
HIGHWAY ENGINEER, and
SENIOR SUPERVISING ENGINEERS.

MANILA, March 6, 1914.

Constructing Division Circular No. 131.

SIR: Your attention is invited to the painting specifications of all regular contracts prepared by this Bureau.

Under paragraph 108 both iron and steel work requires a paint mixed in the following proportion:

	Per cent.
Sublimed blue lead	63
Linseed oil	32
Turpentine drier	5

These are the ingredients of the De-co paint known as De-co inhibitive primer.

After iron and steel work is in place two additional coats are required the pigments of which are mixed as follows:

	Per cent.
Bright red oxide of iron.....	85
Red lead	10
Zinc chromate	5

These are the ingredients of the De-co red top coat.

For the final top coat the specifications call for:

	Per cent.
Pure chrome green.....	30
Lamp black	5
Zinc chromate	5
Yellow ochre	10
Barytes	50

These are the ingredients of the De-co green top coat.

In connection with the use of these paints, you are cautioned that it will be found extremely difficult to secure a uniform mixture with the facilities ordinarily at hand in the provinces. At the same time the coat of the De-co prepared paints will probably be the cheaper in the end. It is therefore suggested that in requisitioning paint as called for under Bureau specifications, paragraph No. 108, you requisition for the manufactured article, that is, De-co inhibitive primer, De-co red top coat, or De-co green top coat, as required. It should be noted that the top coats, red and green, are not interchangeable, and that the red coat is not sufficient without the protective green coat. The result is that in the use of De-co paint, as specified under section 108, the finishing coat will at all times be of a green hue.

For the Director:

E. J. WESTERHOUSE,
Chief Constructing Engineer.

To all DISTRICT ENGINEERS,
HIGHWAY ENGINEER, and
SENIOR SUPERVISING ENGINEERS.

MANILA, March 9, 1914.

Constructing Division Circular No. 132.

SIR: Your attention is invited to Provincial Division Circular No. 109 of this Bureau relative to the planting of shade trees along public highways. The seed of some of the trees named is falling or is about to fall, making this an opportune time for its collection. It is suggested that you obtain a copious supply of seed and prepare to establish nurseries.

This matter should be immediately taken up with the provincial board and an appropriation secured to permit the establishment of a nursery on a permanent basis. It is suggested that if the province does not own suitable land, steps be taken to secure a suitable tract through purchase. No difficulties are anticipated in securing the cooperation of the provincial authorities in this matter.

On July 1 and January 1 next, a special inquiry will be made into the matter of nurseries, and engineers will be expected to make a creditable showing in the propagation of shade trees.

For the Director:

E. J. WESTERHOUSE,
Chief Constructing Engineer.

To all DISTRICT ENGINEERS,
HIGHWAY ENGINEER, and
SENIOR SUPERVISING ENGINEERS.

MANILA, March 9, 1914.

Constructing Division Circular No. 133.

SIR: I have the honor to invite your attention to Accounting Division Circular No. 2, dated May 16, 1910, which, among other things, provides that "In no case shall per diems be allowed to an employee on a project which requires more than thirty days to complete. No per diem will be allowed an employee when directed to change his headquarters, other than for the actual time consumed in traveling from the old to the new headquarters, even should such change afterward prove to be but temporary in character."

It is the general policy of this Bureau to allow no per diems, actual subsistence, or a monthly subsistence allowance in lieu thereof, where employees are permanently assigned to a project which requires more than thirty days to complete.

In many cases employees engaged on port works have in the past been allowed actual subsistence or a specific allowance in lieu thereof. Such allowances will be discontinued after March 1, 1914, and you are directed to so advise all port works employees within your district. Vouchers for such allowances after this date should not be approved by the district engineer.

An exception is made in the case of enlisted men, who will continue to receive an allowance of ₱0.30 per day during the period of their enlistment, and while engaged on port works within your district.

For the Director:

E. J. WESTERHOUSE,
Chief Constructing Engineer.

To all DISTRICT ENGINEERS,
HIGHWAY ENGINEER, and
SENIOR SUPERVISING ENGINEERS.

MANILA, March 28, 1914.

Constructing Division Circular No. 134.

SIR: Attention is invited to the subjoined excerpt from a communication received from the Director of Education:

"Our division superintendents in annual convention recommended, where funds will permit, that all partitions in concrete school buildings be of reinforced concrete 3 inches thick. * * * It is requested that district engineers be directed to put in concrete partitions in all school buildings now under construction and in those to be authorized in the future where the cost of same will not greatly exceed the cost of wooden partitions."

Attention is also invited to attached blue prints of plans for such concrete partitions, successfully used in Bulacan Province. It will be noted that the blackboard arrangement is fixed in the concrete partitions. This special feature is emphasized as it is the desire of the Director of Education that in all cases, where concrete partitions are used, the blackboards shall be placed as shown on the attached blue print. This matter of concrete partitions should be given very careful consideration and the question of cost carefully considered in every school building authorized for construction in the future. Report should be promptly forwarded to the Director of Public Works in case the funds available are not sufficient for such partitions and an estimate of such additional funds as may be necessary promptly submitted.

For the Director:

E. J. WESTERHOUSE,
Chief Constructing Engineer.

To all DISTRICT ENGINEERS,
HIGHWAY AND SENIOR SUPERVISING ENGINEERS.

APPENDIX B.

REGISTER NUMBERS, TYPES, AND OWNERS OF MOTOR VEHICLES IN THE PHILIPPINE ISLANDS, MARCH 10, 1914, TO JUNE 19, 1914.

Register No. and type.	Owner's name.	Register No. and type.	Owner's name.
2812. Motor cycle	Teodoro Abella, Manila.	2906. Motor cycle	Bonifacio Hernandez, Manila.
2813. Automobile	Tee Hankee, Manila.	2907. do	Manuel R. Obispo, Cebu.
2814. Truck	A. L. Ammen, Ambos Camarines.	2908. do	J. W. Hodges, Iloilo.
2815. Motor cycle	C. K. Bradbury, Albay.	2909. do	Bureau of Constabulary, Tayabas.
2816. Automobile	Julian Salgado, Manila.	2910. do	Mathias Hansen, Manila.
2817. do	Bialoglovski & Scott, Manila.	2911. do	E. R. Hartske, Manila.
2818. do	Charles Deber, Manila.	2912. do	W. A. Jones, Manila.
2819. Motor cycle	F. H. Thompson & Co., Manila.	2913. do	Irineo A. San Jose, Cavite.
2820. Automobile	J. A. Thomson, Manila.	2914. do	Adolf Langenheim, Manila.
2821. do	H. A. Sievert, Rizal.	2915. do	Oriental Negros Province.
2822. do	Philip A. Schall, Manila.	2916. do	Bureau of Education, Iloilo.
2823. do	Bureau of Health, Manila.	2917. do	Wm. C. Mitchell, Rizal.
2824. Truck	John Gigling, Moro Province.	2918. do	Jose Piñon, Manila.
2825. Motor cycle	J. C. Hoskyn, Iloilo.	2919. do	Benito C. Cusi, Batangas.
2826. Automobile	Miguel G. Concepcion, Manila.	2920. do	M. D. Munn, Pampanga.
2827. do	John Gibson, Manila.	2921. do	Ricardo Gurrea, Occidental Negros.
2828. Motor cycle	Bureau of Forestry, Manila.	2922. do	F. D. Scott, Albay.
2829. Automobile	Nicolas Catindig, Rizal.	2923. do	C. A. Hamm, Oriental Negros.
2830. do	Victoriano Siguenza, Occidental Negros.	2924. do	Valeriano Segura, Cebu.
2831. do	Catalino Valdezco, Manila.	2925. do	C. H. Reed, Pangasinan.
2832. do	Jose C. Locsin, Occidental Negros.	2926. do	Bureau of Constabulary, Manila.
2833. do	Pedro Picornell, Manila.	2927. do	Ilocos Norte Province.
2834. do	Jose Buencamino Suntay, Bulacan.	2928. do	Warren J. Miller, Leyte.
2835. do	H. B. Parrott, Manila.	2929. do	R. Dixon, Manila.
2836. do	S. L. Bishop, Manila.	2930. do	Carl B. Crabtree, Manila.
2837. do	Gregorio Singian, Manila.	2931. do	Geo. L. Markham, Rizal.
2838. do	Yrineo Encarnación, Batangas.	2932. do	Irving J. Davis, Manila.
2839. do	Conrado Maga, Samar.	2933. do	Singer Sewing Machine Co., Capiz.
2840. do	Joaquin Ledesma, Iloilo.	2934. do	J. McGregor, Manila.
2841. do	Victoriano Seguenza, Occidental Negros.	2935. do	Ira G. Hutchins, Baguio.
2842. do	Antonio Tinsay, Iloilo.	2936. Tricycle	R. S. Gehrett, Manila.
2843. do	Mariano Aguilar, Occidental Negros.	2937. Motor cycle	W. C. Greenland, Rizal.
2844. do	Eladio Roxas, Manila.	2938. do	Ludwig Reichert, Manila.
2845. Truck	Mariano A. Locsin, Albay.	2939. do	Henry E. Smith, Cavite.
2846. Automobile	Henry Birkett, Manila.	2940. do	Bert Terry, Albay.
2847. do	Eduardo Gutierrez, Manila.	2941. do	
2848. do	Alfredo Hidalgo Rizal, Manila.	to	
2849. Truck	Philippine Sugar Estates Developing Co., Manila.	2999. do	
2850. Automobile	Harry D. Gibbs, Manila.	3000. Automobile	Carlos Cuyugan, Manila.
2851. do	Isidra Chango, Manila.	3001. do	W. C. Taylor, Manila.
2852. do	Asuncion N. Jose, Manila.	3002. Truck	Vicente Noel, Cebu.
2853. do	Manila Times, Manila.	3003. Automobile	A. F. Allen, Manila.
2854. do	Antonio Brias y Roxas, Manila.	3004. do	Pio del Pilar, Rizal.
2855. do	Bachrach's Garage and Taxicab Co., Manila.	3005. do	Asuncion Santos, Pampanga.
2856. do	Margarita Catindig, Rizal.	3006. do	Federico Montinola, Occidental Negros.
2857. do	Salvador de la Rama, Occidental Negros.	3007. do	Teod. M. Infante, Occidental Negros.
2858. do	Bernabela de la Rama, Occidental Negros.	3008. do	H. Loewinsohn, Manila.
2859. Delivery wagon	Pedro Alfonso, Manila.	3009. do	Isidoro Santos, Pampanga.
2860. Automobile	Maximino M. Paterno, Manila.	3010. Truck	El Progreso Co., Sorsogon.
2861. do	Guy V. Henry, Rizal.	3011. Delivery	Acrich & Benezra Co., Samar.
2862. Delivery wagon	Fausto Raymundo, Manila.	3012. Automobile	Felino Cajucom, Nueva Ecija.
2863. Automobile	Singer Sewing Machine Co., Manila.	3013. do	R. L. Moseby, Iloilo.
2864. do	Serafin Novella, Occidental Negros.	3014. do	Ignacio Syyp, Manila.
2865. do	Francis Ruggles, Rizal.	3015. do	Benito Valdez, Manila.
2866. do	Farrand Sayre, Rizal.	3016. do	Amando Avanceña, Manila.
2867. do	Vicente Monroy, Manila.	3017. do	R. L. Schley, Baguio.
2868. do	J. E. Reed, Manila.	3018. do	Margarita Quintos, Manila.
2869. do	Gabino Sepulveda, Cebu.	3019. do	Bachrach's Garage and Taxicab Co., Manila.
2870. do	Uy Tiongco, Sorsogon.	3020. do	Juan Martinez, Manila.
2871. do	Eladio Lopez, Tayabas.	3021. do	John Canson, Manila.
2872. do	Abraham Weil, Iloilo.	3022. do	Do.
2873. do	Do.	3023. do	Manuel E. de la Rea, Manila.
2874. do	Do.	3024. do	Juan Ballastreros Aman, Sorsogon.
2875. do	Arsenio Gamboa, Occidental Negros.	3025. Truck	Sorsogon Bacon Transportation Co., Sorsogon.
2876. do	M. Teague, Manila.	3026. Automobile	Maria G. Bernad de Abril, Manila.
2877. do	Jose Buencamino, Bulacan.	3027. Delivery	Do.
2878. do	Bartolome Lacson, Occidental Negros.	3028. Automobile	Remijio Bernardo, Manila.
2879. do	Paz Cuyugan de Veloso, Manila.	3029. do	W. T. Beardsley, Manila.
2880. Truck	Land transportation. Quartermaster Department, Manila.	3030. Truck	P. H. Frank, Zamboanga.
2881. Automobile	Abraham Weil, Iloilo.	3031. Automobile	A. N. Quayle, Manila.
2882. do	Do.	3032. do	Francisco Velasco, Manila.
2883. do	Julio Rafel, Manila.	3033. do	Miguel Lloret, Manila.
2884. do	C. S. Gould, Zamboanga.	3034. do	Domingo Paulilio, Pampanga.
2885. do	G. W. Walker, Manila.	3035. do	Hugo Roseburg, Manila.
2886. do	Bulacan Province.	3036. do	A. M. Guittard, Iloilo.
2887. do	Frank P. Stone, Manila.	3037. do	Juan Galmes, Manila.
2888. do	D. N. Hanna, Manila.	3038. Truck	San Miguel Brewery, Manila.
2889. do	Schober Bros., Manila.	3039. Automobile	H. D. Kneeder, Manila.
2890. do	Bulacan Province.	3040. do	Trinidad del Rosario, Manila.
2891. do	Dionisio Roa, Manila.	3041. do	Gil Montilla, Manila.
2892. do	Jose Ma. Ga. Suarez, Manila.	3042. do	Hilario Florentino, Ilocos Sur.
2893. do	Vicente P. Molina, Manila.	3043. Truck	A. L. Ammen, Ambos Camarines.
2894. do	C. F. Samuelson, Manila.	3044. Automobile	Florencio Gonzales Diez, Manila.
2895. do	Jose R. de Inchausti, Manila.	3045. do	Albay Province.
2896. do	Rufino Rodriguez, Tayabas.	3046. do	Thos. L. Hartigan, Manila.
2897. Truck	Vela Hermanos, Ambos Camarines.	3047. do	Eduardo A. Barretto, Manila.
2898. Automobile	Juan Galmes, Manila.	3048. do	Teodoro Santos, Pampanga.
2899. do	Ramon Zaragoza, Manila.	3049. do	Concepcion Leyba, Manila.
2900. Motor cycle	Martiniano S. Marcelo, Manila.	3050. Truck	Lavin y Martinez, Manila.
2901. do	Dionisio Fernandez, Pampanga.	3051. Automobile	American Hardware Co., Manila.
2902. do	Gilbert Friel, Manila.	3052. Truck	Vicente Golingo, Albay.
2903. do	Howard Van Winkle, Rizal.	3053. Automobile	D. Schumacher, Manila.
2904. do	Charles R. Swanstrom, Manila.	3054. do	Do.
2905. do	J. McBean, Manila.	3055. do	Do.

Register numbers, types, and owners of motor vehicles in the Philippine Islands, March 10, 1914, to June 19, 1914—Continued.

Register No. and type.	Owner's name.	Register No. and type.	Owner's name.
3056. Automobile	Smith, Bell & Co., Limited, Manila.	3075. Automobile	J. E. Ainsworth, Manila.
3057. do	Justino Jimenez, Manila.	3076. do	J. C. Thomas, Mindanao.
3058. do	Margarita Rodriguez, Manila.	3077. do	Joseph Miller, Iloilo.
3059. do	J. U. Kuznik, Rizal.	3078. do	F. W. Dudley, Manila.
3060. do	Maximo Minglana, Pangasinan.	3079. do	Whipple Hall, Rizal.
3061. do	A. S. Ramos, Occidental Negros.	3080. do	Jose C. Abreu, Manila.
3062. do	Leopoldo Brias Roxas, Batangas.	3081. do	Engracia Jacinto, Manila.
3063. do	El Progreso, Sorsogon.	3082. do	Bachrach's Garage and Taxicab Co., Manila.
3064. Truck	Compañia La Union, Leyte.	3083. do	Do.
3065. do	La Insular Cigar Factory, Manila.	3084. do	Do.
3066. Automobile	Gardiner & Dagley, Manila.	3085. do	Ramon Reynado, Pangasinan.
3067. do	Welch, Fairchild Co., Manila.	3086. do	Emilio G. La O, Manila.
3068. do	C. H. Murray, Rizal.	3087. do	Leyte Land Transportation, Leyte.
3069. Truck	Nacional Garage, Ilocos Sur.	3088. do	Winfred T. Denison, Manila.
3070. Automobile	Adriano Campos, Occidental Negros.	3089. do	R. L. Schley, Baguio.
3071. do	Lope P. Severino, Occidental Negros.	3090. Truck	B. Montague, Manila.
3072. do	Anastacia de la Rama, Iloilo.	3091. do	Do.
3073. do	Yap Tecteng, Albay.	3092. do	Do.
3074. Truck	Singer Sewing Machine Co., Manila.	3093. Automobile	John J. Bennett, Manila.

APPENDIX C.

PROJECTS ACTIVE APRIL 1, 1914.

Provinces.	Roads.				Bridges and culverts.				Provincial administration buildings.			Municipal administration buildings.			Prisons.			Schools.				Construction and operation.										Total.	
	Construction.	Maintenance.	Repair.	Reconstruction.	Construction.	Maintenance.	Repair.	Reconstruction.	Construction.	Maintenance.	Repair and alteration.	Construction.	Reconstruction.	Maintenance.	Construction.	Repair and alteration.	Maintenance.	Construction.	Maintenance.	Repair and alteration.	Reconstruction.	Markets.	Parks, grounds, and athletic fields.	Miscellaneous buildings.	Ferries.	Water systems.	Record vaults.	Quarries.	Telephone lines.	Electric light plant.	Miscellaneous.		
Albay	1	2			4			2		1		4		1				6	1			7	1	1							4	35	
Ambos Camarines	6	7		1	4	1																2	1								2	22	
Antique	2	2			3					1								1														12	
Bataan	1	3		2	2																										1	9	
Batangas	5	3			2					1		1						3	2			2	3	2		1					2	27	
Bohol	1	3		2	9													3			2	4									2	26	
Bulacan	3	3			1													2				2										11	
Cagayan	2	3		1	1	1				1								2	1			2		1	1						4	18	
Capiz	3	2		1														2														12	
Cavite	4	2			1													5														12	
Cebu	7	2	1			1									1			7					6	1		1					3	30	
Ilocos Norte	2	2			3			1			1																				1	14	
Ilocos Sur	9	3	1		3	1							2													2	1				3	30	
Iloilo	5	3	1		1						1																				3	20	
Isabela	2	4			2	1																		1	1	1							12
Laguna	2	2	2	4				1																							2	24	
La Union	7	4		1	4																										1	26	
Leyte	3	1			7																											15	
Misamis	3	3			5																											14	
Nueva Ecija	3	2			8																											22	
Occidental Negros	8	3		4																												3	18
Oriental Negros	2	4			1				2																							1	20
Pampanga	2	3			2			1																								3	18
Pangasinan	6	3	1		7							2	4	1																	1	14	
Rizal	7	6		5	1	1																									10	58	
Samar	2	2		1	1																											1	26
Sorsogon	6	2			4																											3	14
Surigao	2	2																														5	19
Tarlac	2	5			2							1																					11
Tayabas	3	3			2					1																						1	17
Zambales	3	2			2					1																						2	19
Total	107	91	5	24	100	6		5	2	6	2	8	6	2	1	1		103											3	1	56	634	

The 56 projects shown under the caption "Miscellaneous" represent 20 surveys and investigations of roads, bridges, dikes, 2 river controls, 1 irrigation system, 1 fence construction, etc.

BUREAU OF PUBLIC WORKS

ORGANIZATION

WARWICK GREENE, *Director of Public Works*

G. C. FENHAGEN, *Consulting Architect*

W. L. GORTON, *Chief Designing Engineer*

H. F. CAMERON, *Department Engineer, Mindanao and Sulu*

C. LINDSEY, *Assistant to the Director*

WILLIAM HIRZEL, *Chief Accountant*

O. K. OLSEN, *Property Clerk*

E. S. GEE, *Record Clerk*

A. K. JONES, *Law Clerk*

L. L. COOK, *Superintendent Automobiles*

CONSTRUCTING DIVISION

E. J. WESTERHOUSE, *Chief Constructing Engineer*

C. E. GORDON, *Highway Engineer*

W. H. WAUGH, *Senior Supervising Engineer*

B. VON SCHMELING (absent), *Senior Supervising Engineer*

HENRY, *Senior Supervising Engineer*

VICKERS (absent), *Superintendent Artesian Wells*

DISTRICT ENGINEERS

ay, Albay

a, Ambos Camarines

Jose, Antique

Renguet

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agayan

Barry, J. R..... Los Baños, Laguna

Clark, L. T..... Tacloban, Leyte

McGregor, J..... Manila

Allen, R. N..... Cagayan, Misamis

Austin, A. W..... Cabanatuan, Nueva Ecija

McGlathery, S. L..... Bacolod, Occidental Negros

Grosvenor, I. R..... Dumaguete, Oriental Negros

Halsema, E. J..... San Fernando, Pampanga

Morrison, C. G..... Lingayen, Pangasinan

Brown, L. R..... Pasig, Rizal

Baugh, N. R..... Catbalogan, Samar

Lilley, H. B..... Sorsogon, Sorsogon

Meehleib, H. R..... Surigao, Surigao

Agcaoili, Romarico... Tarlac, Tarlac

Miles, H. V..... Lucena, Tayabas

Vallarta, Julian..... San Narciso, Zambales

G..... Iloilo, Iloilo

Root..... Laoag, Ilocos Norte

Smith, E..... Vigan, Ilocos Sur

Gomez, Pastor..... Ilagan, Isabela

McComb, D. Q..... San Fernando, Ilocos Sur